Proceedings of the ... annual convention

American Railway Engineering Association

Proceedings

of the

First Annual Convention

of the

American Railway Engineering and Maintenance-of-Way Association

held at

Steinway Hall, Chicago, Illinois
March 14 and 15, 1900

Containing also the Constitution, List of Charter Members, List of Officers for 1900, Standing Committees and Outline of Committee-Work, Mileage of Railroads Represented in the Association, Circulars Issued to Date, Etc.

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1900

J. F. WALLACE, PRESIDENT.

L. C. FRITCH, SECRETARY.

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PROCEEDINGS

OF THE

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OF THE

American Railway Engineering and Maintenance-of-Way Association.

The meeting was called to order at 10:30 a. m. by the President, Mr. J. F. Wallace.

"Gentlemen:—I am much pleased to have the honor to call to order the First Annual Meeting of the American Railway Engineering and Maintenance-of-Way Association, and you will therefore pardon my embarrassment. This hall is very difficult to speak in, particularly for the class of men that are in it to-day, and I hope you will all be as quiet as possible, and that during the actual speaking, either of the chairmen or of the various committeemen, that there will be no going-in or going-out, as the intervals between the different reports will give opportunity for that purpose.

"Before we open up formally and commence the regular order of the meeting, I wish to announce that the Atchison, Topeka & Santa Fe Railway, through the kindness of Mr. J. M. Barr, has tendered us a train that will leave the Dearborn-Street Station this afternoon at 2:30, to take us on a trip to Joliet and show us the Drainage Canal and the Controlling Works at that point, and the various other industries at Joliet, including the rail-rolling process, and that lunch will be served upon that train immediately upon leaving the station, so that if you are detained here with

our work, you may all know that you can get luncheon on the train. If any of you have your ladies with you, and desire to take them with you upon that excursion, you may do so and will be welcome.

"One peculiarity about our Constitution that I notice in looking over the order of procedure, is that the President of the Association is required to deliver an address at this time, and the Constitution also implies that the members are required to listen to it, although that is not stated in so many words.

"On account of the embarrassment that one naturally feels in meeting you all for the first time, I have written this out and propose to read it, if you will kindly pardon me. Instead of reading the minutes of the last annual meeting, I have embodied in this paper a concise history of our Association up to date."

PRESIDENT'S ADDRESS.

"At this, the First Annual Meeting, it would seem proper to state in a general way the problem that is before us for solution, to give an outline of progress to date, and to suggest the general lines upon which our future work should be carried out.

"In October, 1897, a circular letter was addressed to railway officials in the United States, inviting an expression of opinion on the subject of the organization of an association of railway officials interested in or connected with the engineering and maintenance-of-way departments of American railroads. Over one hundred favorable replies were received, approving the movement, and expressing a desire to be identified with the organization.

"In September, 1898, a call was issued for a preliminary meeting, to be held in Chicago during October of that year. This meeting was held October 21, 1898, at the Auditorium Hotel in Chicago, about twenty railroad officials being present.

"Mr. H. P. Robinson, of 'The Railway Age,' called the meeting to order, explained its purpose, and submitted valuable data as a basis for organization. Mr. A. Torrey, Chief Engineer of the Michigan Central Railroad, was chosen Chairman, and Mr. L. C. Fritch, Superintendent of the Baltimore & Ohio Southwestern Railroad, Washington, Ind., Secretary. A committee appointed by the Chairman recommended that the organization be called 'The American Railway Engineering and Main-

tenance-of-Way Association,' and this name was adopted. The Chairman also appointed a committee consisting of five representative maintenance-of-way officials to draft a constitution and by-laws, and to report at the next meeting.

"At the meeting to effect a permanent organization, held in Buffalo, March 30, 1899, this Committee reported a draft of constitution which was unanimously adopted. At that meeting permanent officers were elected and the organization perfected.

"During the past year the officers and Board of Directors have held numerous meetings, selected the chairmen, vice-chairmen and members of the various committees, and revised and perfected the outline of committee-work. This has entailed a large amount of labor, which can hardly be appreciated by anyone not familiar with the actual details of what was accomplished. Great care has been taken in the appointment of these committees. How far this effort has been successful, the future results of the work of the Association will demonstrate.

"The object of the Association, as stated in the Constitution, is the advancement of knowledge pertaining to the scientific and economical location, construction, operation, and maintenance of railroads.

"The present railroad mileage in the United States, Canada and Mexico is approximately 216,714 miles, owned by 2,200 different corporations. Many of these lines, however, while having distinct legal existence, are either owned, controlled, or operated by other corporations. The number of accounting corporations is approximately 1,100, and the number of actual independent operating corporations 850. The railroad properties are capitalized at approximately ten billion dollars, 54 per cent of which is represented by stock—common and preferred—and 46 per cent by bonds. Of the common stock, 66 per cent does not receive dividends, and 16 per cent of the bonds pay no interest. The average rate of dividend on those roads paying any return on their stock is 5.3 per cent—that is, 34 per cent of the railroad stock of the United States, Canada and Mexico pays 5.3 per cent annually on the investment. The valuation of all railroad properties on a 5-per-cent dividend basis would be, in round numbers, seven billion dollars.

"The amount expended on maintenance and structures of all these roads during the fiscal year ending June 30, 1898, was

estimated at $188,000,000. Owing to the more prosperous times, these expenditures have been rapidly increasing, until at the present time they are placed at $200,000,000 annually. It is also estimated that $180,000,000 per annum is being expended in improvements and extensions, provided for out of increased capitalization and not charged to maintenance; this sum covering the construction of new lines, reduction of grades on existing lines, additional tracks, terminal facilities and general improvements to the properties. During 1899 there were 5,493 miles of new railroad added to the total mileage.

"Approximately, 20 per cent of the total expense of operation of all the railroads is due to maintenance-of-way and structures. According to the last official reports, there were 288,000 employes in the engineering and maintenance-of-way departments, at a total compensation of about one hundred million dollars per annum. At the present time this number is no doubt much larger.

"The above figures are, of course, more or less approximations, as part of the data was obtained from official reports one or two years old, these being supplemented by rough estimates to bring the figures down to date. They are certainly conservative, however, and sufficiently accurate to at least lay before you the magnitude of the problem we have to face and to indicate the importance of the work which this Association and the individual members thereof have before us, in the economical maintenance of these important properties. To this end our Association has been formed, and it is desired to bring into it not only civil, mechanical and electrical engineers, whose general professional training may fit them for working out the solution of the technical part of the problem, but also, as stated in the Constitution, all classes of railroad officials having supervision of maintenance-of-way matters, from general managers down to engineers of maintenance-of-way in charge of divisions, or other railroad men bearing other titles but performing similar duties. The term general manager in this clause of the Constitution is used in the larger sense, and is intended to embrace presidents, vice-presidents or other officials interested in the general management of railroad properties.

"You will note that our membership is intended to include two elements—the technical and the practical—and it is hoped

and expected that the intercouse between the technical engineer and the practical railroad man will be of mutual benefit, that the technical man will become more practical and the practical man more technical, through the interchange of ideas and information which this Association is designed to foster.

"It is unnecessary for me to say that this Association fills a long-felt want, and that it has a broad field to develop. If the work is industriously and systematically carried forward it will gradually assist us all in attaining the end sought for.

"It has been the custom of engineering and maintenance-of-way associations heretofore to carry on their work without that system and continuity of purpose which is the only true means of successfully accomplishing the desired results. The work of our Association has been laid out on unique lines. It is the intention to cover the entire field of engineering and maintenance-of-way research, divide up the subjects in systematic order, and continue and increase our standing committees and the subjects under consideration from time to time in order to do so. While a little later on we expect to hear from the chairmen of the fourteen standing committees as to their ideas of the purpose and methods of their committee-work, I would like to state in a general way that it was not the intention, nor is it possible for any of these committees to exhaust the subject-matter given them for consideration in a single year, or even within the lifetime of the individual members. The first work of each committee should be the collection of facts, which should be properly compiled, condensed and abstracted for the information of the Association at large. As the facts are obtained under the different heads or subheads, reports can, of course, be made from time to time by the different committees on these subjects which have been considered.

"But while the committees may increase their membership and subdivide the subject-matters under consideration, assigning different detail subjects to individual members, they should not overlook the necessity and importance of working as a unit and fully comparing and discussing results in committee meetings. When they come before this Association as a body they should come as a unit and act together, and it is expected that they will be prepared to answer all questions that may be asked

by members of the Association in regular meetings, and explain or defend the positions taken by the committee.

"Our progress from the inception of this movement must certainly be gratifying to the members of the Association, but they should not fail to remember that while during this first year of the organization the burden of work has been borne by the officers and directors, from now on the measure of success of our Association depends largely, if not entirely, on the efforts of the individual members.

"We should not forget that we are the servants of the investors in railway securities, and that it is our duty to endeavor to secure the largest possible return on the capital invested. It is the function of the railway to furnish transportation to the public with the maximum amount of speed and safety to person and property, the greatest convenience to its patrons, and at minimum cost. We should have it in mind that the highest economy in the location, construction, maintenance and operation can only be obtained when the interest on cost of construction, plus the expense of maintenance and operation, are kept down to the minimum. It is not economy to so locate and construct a line of railroad that, while the expense of operation and maintenance will be very low, the saving will be more than counterbalanced by the excessive fixed charges due to the original outlay. On the other hand, it is not economy to locate and construct your road so cheaply that while the fixed charges may be comparatively light, the cost of operation and maintenance will be excessive. This principle applies not only to original location and construction of a railroad, but to all the improvements and additions which may seem necessary or desirable after the line has been placed in operation.

"For instance, it may be economy on some roads to make large expenditures in the reduction of grades, if this expenditure will result in a saving in operating expenses in excess of the fixed charges due to the investment. It is economy to construct water tanks of large capacity, if by so doing the service of night pumpers can be done away with and a sufficient amount saved on operating expenses to justify the outlay. It is economy to provide passing tracks if such are necessary in order to facilitate train movements, thereby reducing the length of time consumed by trains on the road or rendering the train service more efficient.

It is also economy to make numerous expenditures upon which no actual saving in operating expenses can be shown, provided these expenditures will develop new business or prevent existing business from going to rival lines, to such an extent as will justify the outlay.

"But the ultimate result of all railroad expenditures is, and should be, net profit to the investor.

"While the question of what is economical management respecting maintenance-of-way and structures is one which the management of each property must solve for itself, we can certainly assist each other by a full and frank comparison of views and a discussion of the various elements that constitute an economical handling of our maintenance-of-way work. The establishment of certain recognized principles as the result of our investigations and discussions will materially assist our managements in adopting a policy that will lead to the truest and highest economy.

"I thank you, gentlemen, for the kind attention you have given me."

The reading of the address of the President was applauded by the convention.

The President:—The next in order will be the reports. I am going to announce the reports of the Secretary and Treasurer, but before we open up our general work, I wish you would all remember that we will not accomplish anything if we let a crust of ice form over this meeting. We should break that up in some way, and we want you to discuss freely the reports of the various committees after they are read. Ask the committees what they mean, and also criticise their statements, and thus assist in obtaining the fullest expression of opinion from the members of the Association. Mr. Hotchkiss, the chairman of the Entertainment Committee (who has done a great deal of quiet work in behalf of the entertainment of the members), states that on tomorrow night the closing feature of this annual meeting will be a banquet at the Victoria Hotel, and we have had a good many responses from members who want to attend. We want to know to-day, after the close of this meeting, or at any time during the meeting, preferably to-day, the names and numbers of our membership who care to attend the banquet. It is going to be a very pleasant affair, and I do not think any one of you will regret

attending. The hour has been changed from that printed in the notice—8 o'clock—to 7:30 o'clock, in order that we can let some of our members get away on the night trains that leave at 11 or 11:30 o'clock. The Secretary will now read his report:

The Secretary, Mr. L. C. Fritch, Superintendent Baltimore & Ohio Southwestern Railroad, here read his report, as follows:

Receipts from fees and dues to January 1, 1900	$2,825.00
Expenses to January 1, 1900	486.91
Net surplus on hand January 1, 1900	$2,338.09
Arrears from fees and dues	700.00
Total net surplus	$3,038.09

The President:—This is all the information we expect to let you have. We are trying to take in this money and spend it, but we have not succeeded in spending it all. What we have spent has been for printed matter and the ordinary expenses connected with the Association. Our expenditures this next year will be larger. After the close of this meeting we expect to issue the first number of our transactions, which will contain the papers that will be read at this meeting and the discussions of the same, and from that time on we expect to provide you with a record in print of all our meetings and the discussions and everything of that sort. The Board has gone into the matter quite largely, and we feel that this is an important part of our work. The greater part of our work—in fact 95 per cent of it—will be for the benefit of the railroad corporations, and after we have demonstrated to the managing officers of our corporations the efficiency of our organization, and that it will be a success, we expect to call on those corporations for a contribution to cover the expenses of our publications, in the same manner that the American Railway Association, the Master Car Builders, and some of the allied organizations do, among which we expect to take our place in the railroad work.

We will now call upon Mr. Sullivan's committee, the Committee on Railway Yards and Terminals.

Mr. Sullivan, will you please come forward, and as the Secretary announces the names of the members of the Committee, they will also please come forward and take their places on the stage.

Before introducing Mr. Sullivan, I desire to remark with reference to our discussions, that it would be of benefit to the reporters and would also assist the Chairman, that when any gentleman rises to address the Chair, he will kindly first state his name, clearly and distinctly, so that the reporters can get it correctly. I will now call upon Mr. Sullivan.

Mr. A. W. Sullivan, General Superintendent Illinois Central Railroad, Chairman of the Committee on Yards and Terminals, here read his report, as follows:

To the American Railway Engineering and Maintenance-of-Way Association:

The problems involved in the yards and terminals of a railroad stand in such intimate relationship to the operation of the line that the one is necessarily a corollary of the other, and a careful adjustment of each to the traffic requirements, immediate and prospective, is essential to the development of the ultimate capacity of the property.

It is conceived to be the function of this Committee to ascertain, by investigation, the conditions within its field of work which are common upon all lines of rail transportation, and by resolution to its elements to determine the principles that will serve to guide in the consideration of all like questions, to the end that there may be established a practice that shall meet with general approval and be recognized as standard.

The practical value of such work, it is believed, will naturally follow with the application of the results of the Committee's deliberations to the problems which arise daily in the work of expanding the facilities of the railways of the country to meet the ever-growing demands of a constantly increasing volume of traffic.

Comparatively few railroads are in a position to consider questions arising in connection with terminal work, free from the limitations imposed by the existence of facilities already established. In many cases the traffic conditions have so changed that the existing arrangements are inadequate to present requirements, and an entirely new plan is needed, while in others an enlargement of existing facilities will serve all necessary purposes. It is not always an easy matter to determine which course is the wisest to pursue, and an investment in the expensive work usually involved in such improvements is apt to be of a permanent character, carrying with it benefits or disadvantages dependent largely upon the skill and judgment of the designing engineer.

It is believed that many errors of design in such work may be avoided by the elucidation of the principles which appertain to the different branches of terminal service, illustrated by typical plans when necessary to a complete presentation, and it is in such work that the Committee hopes to accomplish a purpose useful to all who may be in need of the results of its deliberations and judgment.

The Committee invites discussion and desires an expression of the views of the members as to the direction in which its work may be most productive of immediately useful results.

A. W. SULLIVAN, General Superintendent Illinois Central, Chairman;
F. E. PARADIS, Chief Engineer Chicago Terminal Transfer Railroad, Vice-Chairman;
J. W. THOMAS, Jr., General Manager Nashville, Chattanooga & St. Louis, Nashville;
I. G. RAWN, General Superintendent Baltimore & Ohio Southwestern Railroad, Cincinnati;
E. E. R. TRATMAN, Resident Editor "Engineering News," Chicago;
S. P. HUTCHINSON, Assistant General Agent Pennsylvania Railroad, New York;
R. B. TWEEDY, Chief Engineer Wisconsin Central Lines, Milwaukee;
J. B. COX, Chief Engineer Chicago Junction Railway, Chicago;
C. W. HOTCHKISS, Chief Engineer Chicago Transfer & Clearing Co., Chicago;
C. S. SIMS, Jr., Engineer Maintenance-of-Way Pennsylvania Lines, Chicago;
W. S. KINNEAR, Principal Assistant Engineer Michigan Central Railroad, Detroit, Mich.;

Committee.

Mr. Sullivan, General Superintendent Illinois Central:—I desire to say, in supplementing the formal report of the Committee, that we have so far had but one meeting, which has been quite well attended, and at which, after considerable discussion, we found that there was quite a divergence of opinion as to what the Committee should really do and how it should get at its work.

The first thing that seems desirable to know in connection with the work of this Committee is, as stated in the report, the particular direction of work in which it can commence its investigations, so as to interest the largest number of members, and to put at once before them the greatest amount of useful information. By reference to the plan and scope of the Committee's work, it will be seen that it has quite a broad field. Its freight terminal work will include, in addition to the arrangements for the tracks, the relation to each other of different yards, and would necessarily include the location of structures, freight houses, docks, and the apparatus that is required either at the houses or in the yards outside, to facilitate the handling of the freight traffic of a railway in all its phases.

The problem will present different phases, according to local conditions—whether or not it is to be one entirely of land service

or in connection with lake or river traffic, or in connection with ocean traffic—whether or not the yards are to be made by reducing the natural surfaces of the ground to a level plane or by taking advantage of the inequalities of the surface and utilizing the grades to such advantage as they can be made to yield. The Committee has discussed some of the principles which underlie this work with a view to putting before the Association some idea of the Committee's attitude with regard to its work.

I would say that at our meeting the first question that presented itself in connection with a freight terminal was the length of track which should be taken as a unit for such work. That is, in itself, dependent directly upon the length of train. The train may consist of loads or empties. There are quite a number of opportunities for divergence of views upon that subject.

The next question was the number of tracks that could be economically operated from one lead—whether that should be six, eight, ten, twelve or more. The effectiveness of the operation of the yard will depend largely upon the skill with which it is planned as to convenience in movement and as to the facility with which the work can be done.

The Committee found that the question of the ratio of leads to yard tracks is one in which there was a great deal of difference of opinion and a great deal of doubt. One member expressed the view that it was a question whether it could ever be satisfactorily adjusted. However, that is one of the important questions which the Committee has before it.

Another question was the relation of axes of yards—whether a yard should be planned in a series of parallel yards or whether the relation of one to another should be that of a frog-angle, and in the development of a series of yards whether it should be along parallel lines, or radial lines, or what line would give the best development of the question.

Another question that it has had in mind is as to determining the shapes and areas of land which should be purchased by a railroad company in order to provide intelligently for its future needs, so that such investments would involve the acquirement of the least amount of useless property. I think the experience of railroads generally has been to purchase property in the form of squares, with the result that oftentimes a considerable portion of it cannot be used to good advantage.

The question of grades is also an important one. The matter of the minimum grade required for a gravity yard is one that does not appear to be well established, or, rather, instead of a minimum grade, I will say the best grade—the grade which will surely result in the car starting when released from the brake, and which will carry the car to whatever destination is required with such speed as will not involve hazard to the property.

The Committee feels that it has a field of useful work before it by investigating first and acquiring all the data that it is possible to obtain on the subject, and systematizing and reducing it as nearly as may be to axiomatic rules, to the end that a practice may be established which roads that have not a sufficient organization to take up these questions and sift them thoroughly—that such roads may refer to the work of the Committee and safely rely upon its recommendations as being good practice.

It looks forward to winning from the Association approval of its work, and to the attainment of a standing in keeping with the scope and importance of the subject assigned to it.

The best way in which the Committee can be helped with its work would be to have a free expression from the members in the shape either of criticism [illegible] that the Committee has done, or of what its members [illegible] said, or by asking questions to develop further the [illegible] of the Committee on this subject. (Applause.)

The President:—Gentlemen, the Committee is in your hands. We do not ask you to deal tenderly with them. Pitch into them, if you can. Don't be backward. If none of you gentlemen have the nerve to get up and say something, our entire meeting is going to fall flat and dead. There are among you some, I presume, who have ideas on this question, or some question that you would like to ask this Committee, about their methods of work, or their ideas in reference to the subject-matter.

Mr. G. W. Kittredge, Chief Engineer Cleveland, Cincinnati, Chicago & St. Louis Railway:—It seems to me, Mr. Chairman, that there is one thing that the Committee could discuss with profit, and that is the handling of the switches—the controlling of the switches at the entrances and exits of the yards by machinery—interlocking or otherwise—and while the chairman of the Committee did not mention that as one of the subjects, it can be discussed, and would probably come up in connection with

their work. I would suggest it to them as one which would be of interest. I offer it simply as a suggestion.

The President:—What have you to say to that, Mr. Sullivan?

Mr. Sullivan:—This Committee understands that there is another committee appointed upon that subject, and while it recognizes the advantages that would come from the rapid operation of switches in connection with terminal work, it does not consider that it is now within its field to consider that question.

Mr. H. D. Miles, Signal Engineer Michigan Central Railroad:—Mr. Chairman, that subject has been considered by the Committee on Signaling, and is mentioned in its report.

Mr. P. A. Peterson, Chief Engineer Canadian Pacific:—The Committee has said nothing with reference to the arrangement of platforms, baggage-counters and baggage-rooms for the convenient handling of baggage, so that it can be delivered to passengers arriving in the shortest possible space of time. It seems to me that this is one of the important points that this Committee should consider.

Mr. W. C. Cushing, Engineer Maintenance-of-Way Pennsylvania Lines West:—Mr. Chairman, the chairman of the Committee has stated that it would be difficult to say how long the tracks of the yard should be, but he does not say that it would be an impossibility to establish a relation by percentages between the different sub-yards and the one main yard. Every yard has to be divided into its sub-yards, and it might be possible to state a relation in percentages, that is, car capacity, between these different yards. For instance, if the trains are run in on the receiving track, there has to be a certain capacity in the yard below for handling that business. A great deal of money can be wasted by building these yards below too large—or too small—causing a cramping of the traffic. If it could be ascertained, for the guidance of the different members of the Association, what the percentage in car capacity should be between these two yards (and the same remarks may apply to the other portions of the yards as well), the information would be valuable.

Mr. T. F. Whittelsey, General Superintendent Toledo & Ohio Central:—Mr. Chairman, it has been my experience that tracks in yards are, as a rule, too short, and I think we should aim to have them long enough in all cases to enable the longest

possible train to be handled in the yard, and then to take care of the other features. If you desire to get access to the central part of a long string of cars, you could do so by a system of cross-overs or slip switches in the center of the yard. I would like to know whether the Committee would consider it practicable to introduce that feature into the yards—that of cross-overs in the center of a long system of tracks.

Mr. Sullivan:—The Committee is hardly in a position at this time to state what is good practice. It hopes to be able to determine that question in the course of its career as a Committee and as its work develops before it. The Committee is quite interested in these different questions, because they show the points in connection with its work to which its attention should be directed, and will be glad to hear from the other members.

Mr. C. A. Wilson, Chief Engineer Cincinnati, Hamilton & Dayton:—I have in mind what the President stated about making investments for returns. It seems to me that in designing a yard for a railroad, its present business and capacity is too often all that is considered. The business of the road is growing daily, and in designing a terminal for any railway, the principle should be borne in mind that that yard may be so extended as to avoid throwing away the first investment and provide for the future growth of the yard. We all know that a yard designed to hold a train a few years ago is only half long enough to hold a train of to-day, and frequently the whole yard has to be torn up and thrown away and a new one constructed. It seems to me that in designing a terminal, it should be so designed as to allow for development without the sacrifice of the first investment, and I would like to have the Committee, of course, bear that in mind.

Mr. H. J. Slifer, Superintendent Chicago & Northwestern:—It seems to me one of the most practical features to what might be called the country members, and I place myself with them, is a consideration of sub-heading No. 3, "Passing Sidings," and the elimination of facing-point switches in double-track districts.

Mr. W. G. Curtis, Engineer Maintenance-of-Way Southern Pacific:—I would like to suggest to the Committee that for some of their smaller problems they might formulate general specifications. Take, for example, an intermediate yard, where trains meet and pass, where train-movement orders are given and received, and through which locomotives are to be run without

being detached from their trains, and without backing or breaking up their trains, to have their fires cleaned, cinders drawn and to take fuel and water. The specifications embodying these requirements might be made and plans to fill such specifications suggested by the Committee. Most railroads nowadays are holding their business by making time. The days when freight trains could be started from one end of a division any time and get to the other end at some convenient time have gone by. Nowadays it is of prime importance that trains shall make time.

Mr. C. S. Churchill, Engineer Maintenance-of-Way Norfolk & Western:—The Committee raises one point about the gravity yards, stating that they had not settled upon the grade of the gravity yard that could be properly worked, or at least they had not decided upon what was the proper grade to recommend. It seems to me that that is quite a live question, and I think it is a question that a great proportion of the members here have settled on their roads. I think it is a question on which the results should be given out. I will say that on our road we have two gravity yards that we have worked successfully for many years, and through one of them we classify all our tidewater coal and have handled this coal successfully on an eight-tenths per cent grade—I should say a fall of seventy-five-hundredths per cent is a minimum limit for successful working. Now, I know that is subject to modification, as they say; cars will freeze up and work hard, and probably on some of the Northern roads you may find a nine-tenths per cent grade necessary in the winter; but it struck me, when that statement was made by our Committee, that it is a question on which we can exchange our views and help one another in designing new yards. We have one yard at Columbus, also a gravity, on an eight-tenths grade, that works successfully. As to the length of yards being governed by the length of the trains made up in them, or handled through them—recently we had the matter in hand of lengthening a yard on account of our getting heavier motive power, and we found that the necessity was overcome by building large cars. The fifty-ton car made it unnecessary to lengthen the yard materially, so that I think these questions are in many cases adjusting themselves. You will find that where they increase the size of engines, they are also increasing the carrying capacity of the car itself, so that the total length of the train is not so materially increased. That is, pro-

viding you are handling through the yard one class of business, as was the case in our yard, where we are handling tidewater coal in fifty-ton cars.

Mr. J. A. Atwood, Chief Engineer Pittsburg & Lake Erie:—Concerning gravity yards, I would like to say that the Pittsburg & Lake Erie has at its terminal a yard which is approached by two hundred feet of a lead on a 2-per-cent grade, ending at the point of the first switch, followed by a four-tenths of 1-per-cent grade through the switches, and that again by three-tenths of 1 per cent. These grades are used successfully in winter and summer, principally by empty cars. The heavy grade approaching the yard gives the car a start, which enables it to run a considerable distance on the lighter grades through the yard.

Mr. C. F. W. Felt, Chief Engineer Gulf, Colorado & Sante Fe:—I notice that the heading does not cover specifically the question of shop yards; I think that is quite important and hope it will be included. A question that comes up very often is the relative location of the various parts of a yard—the engine yard, for instance, in freight division yards, etc. I have frequently had a great deal of trouble in getting any agreement on the part of the transportation men as to where, for instance, the scales should be located.

Mr. E. P. Dawley, Division Engineer New York, New Haven & Hartford:—There is one suggestion that occurs to me on the subject that one gentleman referred to—that is the freight houses and similar properties in the center of cities. He spoke of getting property in the shape that was desirable and without unnecessary expense for the land, and I suggest for their consideration (and I think the point is one which may be reached soon), that is to make freight houses two stories, as we see done in some cities where the topography is such as to bring that about. In some places it has been done on that account, and in some other places it has been done where there is no other warrant for it than the expense of real estate. I suggest for consideration the idea of a two-story freight house, with proper grades for track and driveway approaches, so as to provide for the use of two stories for tracks or teams, or both.

Mr. F. H. McGuigan, General Superintendent Grand Trunk:—There is one important feature of the yard track which seems to have been overlooked; that is, the question of team tracks of

easy access. There are very few such tracks in any of our yards, the team track being usually a very long one, holding anywhere from twenty to sixty cars, which are generally placed during the night, and many of them unloaded before 10 o'clock next morning. If a car is required for a load, possibly at a point only a short distance from the team track, on which there is a suitable empty, you are unable to reach it because of the interruption to work and the danger of injuring those engaged in loading or unloading cars. For this reason I have for years thought that team tracks should be arranged by running short spurs, in pairs, from a lead or switching track, as nearly at right angles as possible, with sufficient room for wagons or driveways between each two pairs of tracks.

At the present time, our greatest need is the prompt movement of cars, and I am confident that where possible to arrange team tracks in large cities, as described, fully twenty-four hours can be saved in the movement of a majority of cars. If the Committee think favorably of this suggestion, I shall be glad to have them consider it.

Mr. Samuel Rockwell, Principal Assistant Engineer Lake Shore & Michigan Southern:—Mr. Chairman, we rebuilt two large yards during the past year, in both of which the fact that at once became most manifest was that it was absolutely impracticable to get additional land. I hope the Committee will not neglect to tell us what to do in the matter of rebuilding old yards where we have to adapt ourselves to the material we have on hand.

Mr. Geo. M. Brown, Chief Engineer Pere Marquette:—We built a yard and operated it very successfully where we had the tracks in groups of three, with cross-overs from the outside tracks to the middle track, the cross-overs being ten cars apart. The middle track was kept clear to switch the empty cars on, and was the only track on which the engine need work when pulling ten cars at a time on each outside track. Each of them held thirty cars.

Mr. McGuigan:—Wouldn't you lose three or four car-lengths of room on each track with such cross-overs?

Mr. Brown:—I think we would lose about 120 feet of room, or about three car-lengths.

Mr. McGuigan:—On the plan I suggest you do not lose any space except the ordinary clearance.

Mr. H. M. North, Principal Assistant Engineer Chicago Transfer and Clearing Company:—A previous speaker has mentioned that the Committee might take up the proper location of scales in the shop yards, and I would like to suggest, also, that the Committee take up the most advisable location of scales in freight yards and in classification yards. It would seem at first to be a very simple matter—one would say that the scales should be located at the entrance, but that would limit entrance into the classification yard to the speed with which we could safely weigh cars, and in that way it would deprive us of the use of the classification yard for more than the amount of traffic that could be so handled.

The President:—We will now permit Mr. Sullivan to close his case on behalf of the Committee.

Mr. Sullivan:—The Committee will, of course, consider carefully all questions of detail that arise in connection with this work, but it believes that its larger degree of usefulness will rest, at least for a time to come, in determining some of the questions which an individual is seldom able to determine satisfactorily. It is not often that one person has a sufficient range of experience, or, having the experience, has the judgment, to wisely determine questions which seldom arise in the experience of the individual. Even where a judgment is formed upon individual experience, such judgment can rarely withstand attacks which are brought against it in an association meeting, or even in a committee meeting.

It frequently happens that the judgment of the committee fails to withstand the criticism of the association. If that is so—if the collective wisdom of the committee cannot hold its own against the larger wisdom of the association—it is hopeless for the individual to imagine that he can alone solve the great questions that will arise in connection with railway terminal work.

The Committee will undertake industriously to gather the necessary data and will submit its conclusions to the Association at future meetings, and if those reports will serve the purpose of determining the order in which the facilities of a railroad should be developed to keep pace with increasing traffic requirements, so that the work that has been done to-day will be done perma-

nently, and instead of having to be taken up next year, or the year after, will merely have to be added to, it will be doing for the railways of this country a great deal of good. It will be doing for them, as a whole, a useful work, which will be of value to them.

The Committee thinks it can do something in that direction and will earnestly strive to accomplish a useful purpose and will seek to present to the Association in its different reports the subject-matter of its deliberations in a form that will not only interest them, but be useful to them as well.

I thank you, gentlemen.

The President:—I presume that the proper thing now will be to pass a motion to receive the report of this Committee and order it printed and extend a vote of thanks to the Committee. With your permission we will consider that such a motion has been made and passed unanimously, and will excuse the Committee for the present. (Applause.)

We will now hear from the Committee on Graduation.

I have the honor to introduce Mr. McNab, vice-chairman of the Committee, who will read the report of the Committee:

Mr. W. McNab, Assistant Engineer Grand Trunk:—I have the honor to present the report of the Committee on Graduation, but before proceeding to read it, I would like to state that the absence of the chairman, the Chief Engineer of the Union Pacific, is a source of regret to me personally, and I am sure that it will be a disappointment felt by all the members present. The Association will no doubt understand that this report is simply a blocking-out in a general way of the work that the Committee hopes eventually to accomplish, and the results that may reasonably be expected from its investigations.

I may say that this was the view that the immediate author of the paper had in its preparation, and this thought was considerably emphasized in his mind upon listening to the President's address this morning, in which similar views were so clearly and comprehensively stated.

I will now read the paper.

REPORT OF COMMITTEE I.—ON GRADUATION.

To the American Railway Engineering and Maintenance-of-Way Association:

This report is simply in skeleton form, but intended to indicate in the abstract the subject-matter to be ultimately dissected and collated by the

Committee. It will be our purpose to consider in detail as great a variety of facts and possibilities as opportunities offer, in order that formal reports, to be submitted at future meetings, shall be comprehensive and represent the best modern practice, based upon scientific methods.

There is an extensive range, and due consideration will be given to the limit of economy in original construction, in relation to subsequent maintenance, and how such may be modified in particular cases where the question of finance is a governing element.

Railroad work during the last quarter of a century has taught valuable lessons—not infrequently at great cost—and quite often more valuable experience has been acquired through failures than from that due to successes. In the membership of such an Association as this there must necessarily exist a vast amount of practical experience, covering all points embraced by the several subdivisions of these subjects, and it is the interchange of views of our members that the Committee expects, in order to supplement or modify the principles outlined in this preliminary report.

Standard cross-sections for cuttings and embankments, like standards for other items of railroad work, should be the outcome of the best theoretical knowledge, coupled with experience acquired from extensive and varied practice.

Unfortunately considerable variation exists in the standards of many of the railroads; some only differ in minute points of detail, while others vary more substantially, the logic of the situation being the superiority of some and the inferiority of others.

That such a want of uniformity in standards is the case, even where similarity exists, not only in formation material, but also in climatic influences, and class of railroad using these respective standards, it may reasonably be inferred that, in some, defects exist; and, no doubt, if the nature of these differences be investigated, and the governing principles of the best theory and practice combined be rightly demonstrated, it will result in improved plans, tending to more economical and, at the same time, more efficient maintenance. To this end it is the intention of the Committee to collect and analyze the drawings of cross-sections of standard roadbed of the lines having membership in the Association, together with their specifications covering the work.

After arriving at a decision on the best form of roadbed under ordinary circumstances, for the respective classes of material with which embankments are constructed, or through which the railroad passes in cuttings, consideration will be given to the question of a too rigid adherence to standard or stereotyped plans in localities where, from special surroundings, or local peculiar circumstances, modifications should be made. As instances, the relationship of the angle of repose of any given material to height—i.e., whether or not it is constant; the actual angle of repose most suitable for the various kinds of material; the greater capacity of roadbed ditches for deep cuttings, on account of the greater quantity of surface water shedded by these slopes; the capacity of roadbed ditches increasing toward their outlet in cuttings of extensive length,

through which the track may be level; troublesome pockets of quicksand, which may occur, and for considerable extent; how far, in northern latitudes, the matter of snow in cuttings unprotected by coverings affects the contour of the standard, for there are instances of "bad spots" in certain cuttings, where atmospheric and other local conditions produce drifts not altogether preventable by snow fences.

PROTECTION OF SLOPES.—The permanent character of cuttings and embankments being such an important element in maintenance, investigation will be made regarding the immediate and extraneous causes which necessitate protection. Consideration will be given to the character, method and extent of that protection, as governed by the physical and financial conditions and prospects of the railroad, and to the more ornate, but equally effective, means to be adopted for the neighborhood of town and suburban stations.

Effective drainage being the fundamental element of protection to slopes, the methods for such will bear upon the character of the soil and the source and quantity of water to be taken care of. The contour of the slopes, of cuttings and embankments, with reference to the shapes ultimately taken by natural causes, will be investigated, in order that the general practice of angles in intersecting planes may be modified advantageously.

Notes will be made on the friction and cohesion of soils in reference to the theory and practice of retaining walls, and, in regard to the latter, their various styles, method of construction, and materials of which built—masonry, piling, wooden wharfing, etc., and instances in which each of these methods may be used to advantage, and the particular provisions that will be best to make with reference to their foundations, drainage, etc., will be dealt with. Not only will the question of retaining walls in cuttings and embankments to prevent landslides be investigated, but also the protection of embankments from scour by water in large volumes, either by current or waves, including rip-rapping, revetments, paving, etc., and the best plans to be adopted to meet them in a general way. In this particular the Committee hopes to be assisted by descriptions of particular cases.

Regarding sodding and seeding, it is evident that the slopes should have a certain amount of preparation beforehand by being put into reasonably proper shape, but the necessity in certain instances of a coating of soil, the quantity and thickness of such soil, quality of the field sods, their thickness, the method of staking them down, the best class of seed, according to climate and soil, and the method of saving it, as well as the cost of doing so, will all receive due consideration.

The planting of willows will receive attention, together with the nature of the soil for them, the manner in which their roots permeate the ground and act as a check against any tendency of the earth to move in large quantities, and their susceptibility to close trimming without impairing their vitality to a marked extent. Under this head will come also the advantage of planting scrub bushes in abundance on banks with a tendency

to break or slide, or where, in the case of sandhills, the material is likely to be reduced by being blown away.

When building a railroad it is often the case that really good material from cuts is wasted, in order to save haul, whereas, at reasonably additional first cost, it might, in many instances, be saved and dumped over embankments to a sufficient depth to allow the quick formation of a good sod from seeding, which would not wither up during droughts.

IMPROVEMENT OF GRADES AND ALIGNMENT.—In the matter of gradients and curvature, the forethought of even the most far-sighted of the earlier engineers has proved in recent years to have been insufficient to cope with the economic principles of modern transportation. This section will, therefore, naturally be considered as referring not only to the improvements of existing lines, but also to the alignment for proposed roads—although each line will probably have its own unique features, commercially and physically, so that comparisons cannot be made in detail; still there are general features that can be based upon the experience of the older lines, and it is expected that the methods to be suggested will be such that they can be reduced to a practical form.

Of course, there are many instances where the physical conditions of the country traversed will only permit of sharp curves and steep gradients, except at an absolutely prohibitive cost. At the same time, the railroads, or sections of railroads, are equally numerous where improvements can be made in curvature and gradients, which, in the aggregate, will largely reduce the track and rolling-stock maintenance, as well as cost of transportation, and, in a large ratio, to the actual outlay for these improvements.

In the earlier days, on the more important railroads, the question of ultimate cost of maintenance and operation does not seem to have been as important a factor as that of shortening the line between the main points, the results of which were "ruling" gradients, and frequently at awkward points; while in later times, in many instances, the other extreme has been resorted to and unnecessary circuitous locations adopted.

The question of what is the steepest grade or sharpest curve for economical operation cannot be answered without reckoning on the immediate physical conditions of the road in proximity to each particular ruling condition, and in this the Committee expects to make investigations into the train-resistance generally, due to grades and curves, and the actual cost of overcoming this resistance in actual practice.

Consideration will be given to the features in which a new location may be preferable to improving the present one; also to particular cases of reduction of curvature, as well as that of gradients, in both of which latter cases more or less new location may be involved, and the substitution of vertical curves for the intersections of planes at changes of grade.

These improvements, together with others of a minor character, will also be considered in reference to extension for double-tracking, in all of which steam-shovel work and other methods will be dealt with in regard to their most economical and systematic workings.

The elevating or depressing of tracks in large cities in order to abolish

grade crossings will be considered, in reference to the best methods to minimize the cost and to give the least interference to traffic during the progress of the work.

TUNNELS—VENTILATION AND MAINTENANCE.—It will not be the province of the Committee to enter into the question of the necessity for tunnels in certain locations, nor the simplification of the problem of ventilation by the substitution of other motive power for ordinary coal-burning locomotives at present in use, but rather to deal with the principles of ventilation as applicable to tunnels of various lengths, sections, and features of location, with present class of locomotives.

The condition under which natural draught for ventilating purposes is effective will be considered, and the elements tending to retard such; and in regard to artificial means, when such is required—the nature of failures, the various methods adopted, their capacity, effectiveness, requirements, cost of working for the results obtained, etc., will receive consideration, as well as the atmospheric and other conditions under which maintenance is necessary, and the means adopted to that end.

J. B. BERRY, Chief Engineer Union Pacific, Omaha, Neb., Chairman;
W. MCNAB, Assistant Engineer Grand Trunk Railway, Montreal, Can., Vice-Chairman;
J. A. ATWOOD, Chief Engineer Pittsburg & Lake Erie Railroad, Pittsburg, Pa.;
R. C. BARNARD, Engineer Maintenance-of-Way Pennsylvania Lines West, Cincinnati, Ohio;
G. M. BROWN, Chief Engineer Pere Marquette Railroad, Saginaw, Mich.;
H. BALDWIN, Engineer Maintenance-of-Way Cleveland, Cincinnati, Chicago & St. Louis Railway, Indianapolis, Ind.;
C. DOUGHERTY, Roadmaster Illinois Central, Chicago;

Committee.

The President:—Gentlemen, if the Association discusses this subject-matter as well as the Committee has presented it, we will have a very valuable discussion. The matter is now open to the members. I do not want you to think that the question is exhausted, because it is not.

Mr. D. Bontecou, Chief Engineer Kansas City, Fort Scott & Memphis:—It occurred to me, in hearing the report of the work of this Committee, that while sometimes it is not difficult to compute the advantage of spending money in improving a maximum grade, the operation of the grade being a source of heavy expense, yet there is a class of very difficult questions that come up in case of the small grades, where you know perfectly well that a train will run down through a sag and up to the other side by its momentum, with no extravagance in fuel or train expense, and everything safe except, possibly, the chance

of a break-in-two accident, or some other inconvenience which may only occasionally arise. I think there is no doubt but that we always realize that in a great many of those cases it is not worth while to expend money. But cases arise, as details of extensive plans of improvement, which are difficult to decide. I believe that for my own part I would prefer to have guidance on questions of that kind in deciding how far it is worth while to go in the improvement of short, unimportant grades.

Mr. McNab:—The point that Mr. Bontecou has taken the Committee has in view, that is, the physical conditions of the road on either side of the grade or grades proposed to be reduced will have to be taken into account. I appreciate Mr. Bontecou's remarks. The steepest grade may not necessarily be the ruling gradient; but the direction of the heaviest traffic, and the features of the road on either side of the grade proposed to be reduced which accelerate or retard momentum will all be duly considered.

Mr. O. D. Richards, Chief Engineer Ann Arbor Railroad:—I think the original grades on most railroads are established too low for economical maintenance after they are in operation. I wish the Committee would take that into account, and by recommendation or otherwise, call attention to the matter. It would, perhaps, have a tendency in the future to correct the error, even at the expenditure of a little extra time and money, as it would be cheaper in the end.

Mr. S. P. Hutchinson, Asst. Gen. Agent Pennsylvania Railroad:—In regard to the remarks of the gentleman about a mistake that is sometimes made in reducing small grades, I may say that on the division to which I am attached our heaviest grades are not our controlling grades, that is, when we have a good approach, the train gets a momentum and can get over without any trouble whatever. Our ruling grade is at present nine-tenths, our heaviest grade is a foot and three-tenths, but we are now considering the question of reducing our nine-tenths grade, because that controls our tonnage.

The President:—Some years ago I was on a line where the question of changing the alignment had been very thoroughly considered, and for several reasons, three or four different locations had been adopted from time to time, and afterward abandoned. On one or two of those lines there were tunnels which

the engineer said the company had for sale. I think Mr. Curtis can tell us something about it.

Mr. W. G. Curtis, Engineer Maintenance-of-Way Southern Pacific:—I thought you were talking about the Southern Pacific. Those changes that you referred to were washout changes, I think, that were in the Solidad Cañon in Southern California, where there was certainly a climatic change. The railroad had been built for about seven years, and at that time the cañon showed no evidence of great floods; trees of great age were growing upon it, none of the older people who had lived there—the Mexicans—had any knowledge of floods, and the road was built close to the bottom of the cañon. In 1884, some eight years later, there came a series of tremendous floods, and before they were well over, among other things, the bottom of the valley had lowered itself something like twenty feet. Commencing at the lower end of the cañon, it cut down a precipitous face for itself and gradually worked back, until some eight or ten miles through the cañon had been changed.

That same sort of thing occurred later in Arizona, in the Cienega Cañon, the bottom of which lowered itself eight or ten feet. When the road was built there was not the slightest evidence that the floor of the valley had ever been lower, although after this erosion occurred the rock walls of the cañon were worn smooth, showing that that condition had existed there before.

The same thing in the Sonoita Cañon, Arizona, is going on at the present time. We have guided that channel to suit ourselves. We have cut down the trees and guided the course of the erosion and have got the channel into a pretty good line there.

About the momentum of grades, we are thinking about them a great deal lately in connection with the locomotive tonnage ratings. As has been suggested, the locomotive problem has been greatly changed in recent years. Our locomotives to-day are twice the capacity of those of ten or fifteen years ago, and in connection with the rating of locomotives, to settle all questions open between the maintenance people and the motive-power people, a committee has been appointed made up of the superintendents of motive power and engineers of maintenance-of-way and mechanical engineers of the Southern Pacific Company.

Well, we began the thing and have nearly completed it now on a theoretical basis. We have plotted an operating profile

continuously over the entire line, and that method has developed the momentum of grades. Of course, it is a fact that the actual maximum grade is not the ruling grade in many cases.

I know of one instance where in three hundred miles the average rise of a valley is such that on the shortest line a ruling grade of four-tenths per cent could be adopted for that entire three hundred miles; the present maximum grade is something over 1 per cent, and we find, in connection with this locomotive rating investigation, that to get the best out of that situation—to get the equivalent of four-tenths per cent grade—we need not change line or grade very much when the line is remodeled, as it probably will be, and grades reduced to the equivalent of four-tenths per cent. It will still have many 1-per-cent grades descending into and rising out of the sags.

In connection with locomotive rating, we define one unit of locomotive power as 1,000 pounds available at driving-wheel rail contact to haul locomotive and train, and from a continuous virtual or operating profile is determined the load in "M's" that can be hauled per unit of power. A load of one thousand pounds we define as one "M." Individual locomotives are rated by multiplying their units of power by the load haulable per unit. We rate our locomotives entirely on a tonnage basis.

The increase in the locomotive power, of course, introduces a great variable into all these questions of grade reduction, since we are assuming a maximum trainload. With us, fifty thirty-ton cars, fully loaded, is about as many cars as we can safely pull in a train, and we are assuming that no larger locomotives will be used than necessary to pull that maximum train over each division.

The method of this Southern Pacific tonnage-rating committee, I do not suppose, is new, but if the Committee of the Association, whose report is now under discussion, wishes a full statement of it, I am sure our General Manager will be glad to give it to them.

Mr. H. G. Kelley, Chief Engineer Minneapolis & St. Louis: —The scope of the matter to be considered, as outlined in the report of the Committee upon Graduation, is so complete that little can be said at the present time in the matter of suggestion, but among the many items which occur to my mind, I would like to call to the attention of the Committee the trouble experienced

in maintenance-of-way departments by sliding and unstable banks.

The first consideration would be to arrive at the cause of the trouble, and from my own experience I would say that the cause of sliding banks, in many instances, arises from defective original construction, as well as from bad material. As an example, I will call attention to one item that came to my attention some years ago. An embankment 25 feet high and about 1,000 feet long had commenced sliding shortly after construction, within a period of three or four years.

The ordinary method of curing troubles of this kind was applied in this case, which consisted of dumping more material upon the already overburdened bank, but, naturally, this did not reach the trouble, and when the matter was brought to my attention, a careful study of the nature of the soil on both sides of the embankment was made, and it was found that the top soil was a light clay loam and the substratum a heavy blue clay. I then cut the bank in two, and found that the lower portion of this embankment had been made from borrowed material, and the upper portion had been overhauled material from surface cuts and that there was a well-defined plane of cleavage between the two materials. The incline runway of the scrapers was well defined and the sliding of the embankment occurred on this plane. There had been expended upon this embankment, up to the period when it came to my knowledge, some $10,000.00. It was cured permanently at a total cost of $1,200.00, by the following method: We excavated longitudinal trenches on the side slopes and foot of the embankment and then cross trenches between these longitudinal trenches. These trenches were then filled with old pile heads and ties and refilled with the clay excavated from them. The mass was then fired and smoldered for upward of six weeks, more clay being added in the trenches as the material in them settled down.

The result was that the sliding bank was practically made into a mass of brick, and has never moved or settled since that date, about six or seven years ago. I have applied this method since then to other embankments which contained clay, and with uniformly successful results. The point that I desire to draw is, that the original construction of this embankment was at fault, for the reason that the borrowed material used in making the

base of the embankment should never have been put in with an inclined-top plane. Had it been put in level the probabilities are that the embankment would not have slid.

The President:—We had a very singular experience on the Illinois Central Railroad, in some of our embankments. We have had embankments that were constructed fifty years ago, and up to a few years ago showed no signs whatever of sliding. During a wet season—which was no wetter than the usual seasons we had passed through before—we had some very extensive slides, and it is quite a serious question whether there is not something in an idea that one of our subordinates suggested—that with the increase of speed and weight of trains, if there is not an effect on the embankments and on the masonry that tends to disintegrate them and to overcome the cohesion between the different particles of the mass, that tends to weaken the embankments, particularly where the service is very severe—where trains are numerous and the weights of trains are heavy and speeds are high.

Is there any further discussion on this question, gentlemen?

Mr. C. F. W. Felt, Chief Engineer Gulf, Colorado & Santa Fe:—I think perhaps some of you have had experience in running across some old line that was laid with very choppy grades —short grades that did not control the train-loading at all, but where the question of break-in-twos came up. I think that is a point that should be investigated.

Mr. McNab:—The Committee will take note of the remarks that have been made by the several speakers and give them due consideration. I may say that we have quite a contract before us, as the Chairman has intimated, and while we do not expect to cover the whole of it in one year, or even two years or more, it is our purpose to do our work thoroughly, and by the next meeting to have some parts of it in sufficient shape that it will stand against an overhauling—as our President practically expressed it a while ago—and we have in view that with these reports from year to year, the output of this Association will practically become the text-books on maintenance-of-way matters as time goes on.

Personally, I think that fewer books on maintenance-of-way will hereafter be written by private engineers, and that the records of this Association will be looked upon as standards in that respect for the time being. While, as I say, we have a con-

tract before us, our Committee is small, and it may be necessary for us to increase that Committee, and it certainly will be necessary for us to apply to members of the Association to supplement our information and knowledge, it is to be hoped that this information, when applied for, will not be shelved over into some more convenient season.

Of course, now we are all enthusiastic and we all have sanguine expectations of the results that are to be obtained ultimately from these reports, and while we will all leave here tomorrow with the very best intentions, the cares and routine of everyday life will come up and there will be the tendency to postpone Association matters until some other time.

Now, it seems to me that to the members generally in everyday life some thought will occur to them now and again that would be of use to the Association, and if these little thoughts were just jotted down from time to time, not necessarily to be acted upon at the moment, but just entered in a notebook, or in some other form, and elaborated as opportunity offered, good results might be obtained.

We know that winter is going away and spring, with spring work blending into summer work, is almost at our doors, but still the busiest man is often the man who has the most leisure if he is systematic, and if some little means of the kind I have suggested were adopted, the Committee, in applying to the members generally, will have no difficulty in obtaining information, and obtaining it in as speedy a manner as circumstances will warrant.

The President:—I think Mr. McNab's remarks are very pertinent, indeed, and the suggestions are valuable, and I hope you will carry them out. He is right in thinking that the reports of these committees in time will be text-books on these matters; and there is also a matter that is in our minds, and that is, that these reports at this meeting may be introductory to those books. And another thing he is right in, and that is, that we expect to cover the entire field, and we are practically in a trust on maintenance-of-way matters, if we do our duty.

If there is no objection, we will consider the former motion made and carried, and we will receive the report and thank the Committee, and excuse it temporarily.

Recess of ten minutes.

The President:—The Committee on Buildings will please come forward.

Before we take up the work of this Committee, the chairman of the Entertainment Committee wishes me to announce that the train on the Santa Fe will leave at 2:30 p. m. sharp, from the Dearborn-Street Station. We also want to announce that if there are any here who are invited as friends of the membership of the Association, who are not members of the Association, whether they are supply men or not, they are perfectly welcome to go along on that train.

We would like to say, in reference to the supply men: We have endeavored to divorce our Association from the supply men solely for the reason that there have been associations of this kind who have relied on the supply men to entertain them, and carry them around at their annual meetings and that sort of thing, and we did not think that was proper. We have formed our Association for the scientific treatment of our business, and we want to conduct it in a business way, and we want to stand on our own bottom. (Applause.) We want to treat the supply men courteously, because they perform a very important function, and while we do not want to be their guests as an Association, we have not any objection to the individual supply men being our guests and we want them to be regarded as our friends. But this Association is for a distinct purpose—honest, hard work, and not entertainment.

We will now hear from the vice-chairman of the Committee on Buildings. The chairman is Mr. Berg, but he is unavoidably absent.

Mr. H. W. Parkhurst, Engineer Bridges and Buildings Illinois Central:—I should say by way of preface that the introductory paper is by Mr. Berg. It is a brief review by the chairman of the Committee as to the best method of procedure for conducting the work of the Committee on Buildings. I would further say that, owing to the fact that no two members of the Committee live in the same place, there has been no previous meeting of this Committee. They are practically strangers to each other.

REPORT OF COMMITTEE VI.—ON BUILDINGS.

To the American Railway Engineering and Maintenance-of-Way Association:

The following is a brief review by the Chairman of the Committee as to the best method of procedure for conducting the work of the Committee on Buildings:

The scope of the Committee's work is so extensive that the only possible method to handle it properly will be to appoint sub-committees. Knowing full well from my own experience for years that the chairman of a committee generally does all the work, I believe if the two principal subjects should be divided among the twelve committeemen as chairmen of subcommittees, that we would get the best results. On the other hand, it is preferable to have more than one member on a committee.

I suggest, therefore, that the work of the Committee be grouped under six heads, and two members assigned to each group, or that the Committee be extended so as to have twenty-four members, two to each of the twelve subjects.

Each member should be asked for his preferences in the choice of subjects, giving first, second and third choice. The assignment of subjects could then be made with reasonable certainty that each subject would be handled by an expert, or at least the work be one of pleasure, with corresponding profitable results to the Association at large.

As the general principle underlying the Association's work is the collecting, classifying, systematizing and disseminating of engineering information connected with railroad work, and not the aim to create official standards sanctioned by official representative votes, the work will be largely dependent upon the enthusiasm displayed by the individual members of the Committee, more particularly the sub-chairmen. Success will be proportionate to the care shown in the choice of the proper men to handle the various subjects.

I suggest that the Chairman of the Committee should make a canvass of all members as to their preferences, and then assign the subjects to them. That the two or more members assigned to a sub-committee should prepare a report, which should be transmitted to the Chairman in time to enable him to examine same and send copies to all members of the full Committee some time prior to the annual convention. That, prior to the convention, say the day previous, the full Committee should be called together and pass on the reports of the various sub-committees, and determine whether to present them to the convention. The report of each sub-committee should be signed by the chairman and members of the sub-committee, and further by the Chairman of the Committee on Buildings, with notation that the report had been approved at a meeting of the Committee.

One point should be carefully watched—namely, any attempt to advertise patented or trade articles. Further, the reports should be more in the nature of summaries of best practice and not detailed descriptions.

In many cases drawings would necessarily have to accompany the

reports. If properly prepared tracings or photographs are furnished, the expense of publication is small.

There is no doubt that all engineering work is tending toward specialties, and railroad architectural and structural work is not an exception. The field is large, and railroad buildings daily being more and more recognized as a specialty, necessitating a knowledge of the railroad requirements, in addition to ordinary structural ability and designing experience. The average architect is lacking in knowledge of the railroad requirements, whereas the engineer is wanting in architectural taste and experience. The railroad architect and structural designer is the result, and the work of the Committee on Buildings will play an important part in the development of this important specialty of railroad work.

W. G. BERG, Chief Engineer Lehigh Valley Railroad, New York, Chairman;
H. W. PARKHURST, Engineer Bridges and Buildings Illinois Central, Chicago, Vice-Chairman;
P. D. FORD, Chief Engineer Long Island Railroad, Richmond Hill, N. Y.;
E. C. MACY, Engineer Iowa Central, Marshalltown, Iowa;
C. E. BRYAN, Superintendent Maintenance-of-Way Ohio River Railroad, Parkersburg, W. Va.;
C. MILLARD, General Manager Chicago, Peoria & St. Louis, Springfield, Ill.;
B. C. GOWEN, Chief Engineer Wisconsin & Michigan Railway, Wausau, Wis.;
M. W. COOLEY, Assistant Engineer Construction Baltimore & Ohio, Baltimore, Md.;
A. S. MARKLEY, Superintendent Bridges and Buildings Chicago & Eastern Illinois, Danville, Ill.;
C. T. NORTON, Superintendent Road Department Mexican International Railway, Ciudad Porfirio Diaz, Mex.;
H. PIERCE, Engineer Maintenance-of-Way Chesapeake & Ohio, Huntington, W. Va.;
I. F. WHITE, Superintendent T. & S. Cincinnati, Hamilton & Dayton, Hamilton, O.;
G. W. VAUGHAN, Supervisor Bridges and Buildings New York Central, New York;
J. D. ISAACS, Second Assistant Engineer Maintenance-of-Way Southern Pacific Company, San Francisco, Cal.;

Committee.

The President:—In reference to the first suggestion made by Mr. Berg in his report, I would like to explain to the Association the manner in which these committees have been selected.

In the first place, the Board of Direction has selected the chairman and vice-chairman of the committee; then it requested the chairman to nominate his own committeemen. Those nominations came to the Board, and it was found, as expected, that a

great many times one man was nominated on half a dozen different committees, and, of course, it was necessary for the Board to supervise the selection of these committees and to make a selection so that one man might not be on more than one committee, and in order that different railroads of different parts of the country might be properly represented.

It was realized that there would be some difficulty in getting these committeemen together, but a general representation on the committees was very essential. The question of the men getting together is a matter that will gradually work out itself.

In regard to the number of men on the committee, if any chairman desires more committeemen, it is his privilege and duty to notify the Secretary that he would like to have his committee increased by so many members, and if he would like to have such and such gentlemen serve on that committee. If he exercises care in selecting men that are not on other committees the Board will conform to his wishes as nearly as possible, but it is not desired to put the work all on one set of men. It is desirable to extend our committee membership to the entire Association.

The chairmen of the various committees will bear this in mind in making nominations for the extension of the membership of their commitees. The question is now open for discussion.

This preliminary report, of course, is merely an outline of the way this work should be carried on, but if there is no objection, and it is desired, and any member has any suggestion—not only in regard to the matter of the committee-work, but in regard to the way the subject should be treated—it will be well for them to make their suggestions at this time, or ask the Committee how they intend to handle it.

Mr. E. E. R. Tratman, Resident Editor "Engineering News:"—I would like to suggest that this arrangement practically makes the Committee's report a compilation of sub-committee reports. According to the plan outlined, the sub-committee reports will only be considered by the general committee one day before the meeting. That will necessarily be largely perfunctory; there will not be time to digest and consider the various subjects. It seems to me that it would be better for the subject to be con-

sidered by the Committee as a whole and the result embodied in one general committee report.

The President:—I think that this criticism is very well taken.

Mr. Parkhurst:—The practical difficulty is in getting the Committee together for the general consideration of a series of sub-reports in any other way except prior to some convention or some important occasion. The men are scattered from Maine to California, or from Oregon to Florida, and it is pretty hard to get them together, because they are busy men, and there would necessarily be very few that could attend such meetings. That was the reason for the suggestion that these sub-committee reports be considered at a time just prior to the annual convention or at the time of making the full report before the convention. I think they might be supplemented by correspondence and transmitting them from one portion of the Committee to another, but I do not very well see how we could insure any fuller discussion in the Committee.

The President:—Mr. Sullivan, you have had a great deal of experience in handling these committees in the American Railway Association. Will you give us your ideas on the subject?

Mr. A. W. Sullivan, General Superintendent Illinois Central:—With reference to the manner of performing the work specified by the Committee, I apprehend that it will fail to serve the most useful purpose that comes from committee-work, and that is to develop the collective wisdom of the Committee.

The strength of committee-work usually lies in the fact that it gives the opinion of no one person. The opinion of some one person may start a movement, may direct the line along which inquiry is made, may possibly direct the thought of the committee, but the judgment of the committee will of necessity carry weight, if it be that of the committee as a whole, and, being the judgment of many persons, is more likely to stand against the broader judgment of the convention.

The point I had in mind, listening to the report of the Committee, was, What suggestion does it contain as to a typical plan of a station? Possibly I may not have taken a right view as to the scope of the Committee's work. My idea as to that scope was that it should include the uses of the buildings as well as the construction of them; in fact, the use of the building is more likely

to be the higher purpose, and unless there can be a consensus of opinion resulting from investigation by the Committee as a whole, I do not see how they can satisfactorily develop typical plans for the various classes of buildings required.

It seems to me that, to get the best results along those lines, would necessarily involve the work of the Committee as a whole; to make the work of the Committee most useful to the Association would be to lay before its members typical plans which the Committee will stand back of and say, "These are the best plans to meet the requirements of actual service under given conditions."

Then any member who has occasion to consider the question would naturally turn to the work of this Committee and recommend the adoption of such of its plans as would be most useful, and in that way its work would tend to bring about uniformity of service at stations, as is being done in other branches of railway service.

Mr. Parkhurst:—I think the conception of the Committee, as indicated by the last speaker, is somewhat different from that held by the chairman of the Committee. If you will note, he says that the "principle underlying the Association work is collecting, classifying, systematizing, etc., engineering information," and not "to create official standards sanctioned" by the Association. With that idea in mind I think the plan of work as outlined would be more satisfactory, perhaps, than it would be with the other idea in mind—that is, preparing a standard, or suggesting a standard; that would be a development which would follow the ascertainment of present practice. The present practice might be obtained from sub-committees of one or two men and collated.

The labor of correspondence and combining plans, something of that kind, can be handled by a small committee, just as well as by a large committee; then the action of the large committee might be taken to suggest, and perhaps present, a standard or typical plan of a given class.

The President:—The policy of the Association in all these matters will be in the hands of the Association. So far as this policy is announced to date it has been an expression of opinion of a majority of the Board of Direction. It was thought that the idea of committee-work should be the col-

lection of facts, then follow with recommendations, but that was a mere suggestion as to the way the work should be conducted on some committees; the question necessarily involves the consideration of Mr. Sullivan's suggestion.

The object of these discussions is to bring out and get the ideas of the members of the Association themselves as to what would be the proper and the best way to carry on committee-work, and we want the fullest and freest criticism and suggestion of ideas in relation to it.

Mr. Sullivan:—One word more. I would like to have the Association consider whether or not I am correct in the assumption that there is a distinct difference between standard plans and typical plans. For instance, I feel that the Committee can submit to the Association typical plans, illustrative of its idea, without in any manner committing the Association to an indorsement of that plan; but, on the other hand, a standard plan, accepted by the Association, would carry with it the weight of the Association indorsement, and it is quite probable that on many things the Association would not be willing to indorse any given plan as being a standard. It could have no objection to a plan being submitted by a committee as a typical plan, and in that way, by holding to that distinction, we can, I think, enable the committees to submit the plans with the committee's approval, which can go forth in the proceedings of the Association without, however, necessarily carrying the indorsement of the Association.

Such plans are useful to the members at large throughout the country, and it is quite desirable that there should be some means of laying them before the railway people generally, but without wishing to carry with it any official indorsement. It has occurred to me, and I submit the idea to the Association at this time, that there is a proper distinction between typical plans and standard plans, and it would be of value, I presume, to this Committee—I know it would be to the Committee of which I am chairman—to know whether the Association indorses that idea.

Mr. C. A. Wilson, Chief Engineer Cincinnati, Hamilton & Dayton:—I think Mr. Sullivan has very clearly presented the difference in that distinction between typical and standard in

the work of the Committee that he has been engaged on and the committee-work that would be done by this Association.

The American Railway Association, probably, can establish standard plans, being an association of railways and not of individuals. This is an association of individuals and not of railways, and it seems to me that that idea of Mr. Sullivan is one that we ought to follow—not to attempt to establish standards, but types.

Mr. W. McNab, Assistant Engineer Grand Trunk:—I would ask the vice-chairman of this Committee whether what will be considered in reference to standard or typical plans (whichever they may be called), will have reference also to the general layout and the general conveniences that will be afforded the patrons of the road, and whether it will deal also with the external features of the building itself.

There are instances where railway stations have been constructed at great cost, and on taking up guide-books of the country descriptive of the city or town in which the respective stations are located, one finds amongst the elaborate specimens of architecture the railway stations particularly noted. One looks at them and finds, perhaps, large towers and other attributes of architectural elegance, which do not add particularly to the comfort or convenience of the patrons of the road. In such cases those cities or towns, as a general rule, do not contribute anything toward this advertisement that they indirectly get. I mention this merely that the Committee might take into consideration whether or not more money should be expended on the conveniences that the traveling public and the patrons of the individual roads are to get, as against the advertisement that the city or town is getting for some of its architectural features at the sole expense of the railway company.

Mr. Parkhurst:—I think this suggestion is a very desirable one for consideration, and the Committee will undoubtedly take it up. As I have already stated, unfortunately the Committee has not had a meeting, and no elaborate method of procedure has been evolved as yet.

The President:—In reference to the remark of Mr. McNab, I think our Committee should do one thing which a great many of our architects have failed to do, and that is to arrange for the decoration of the construction, and not arrange for the

construction of their decorations. It is one great trouble with many of our railway stations that that principle has been overlooked.

Mr. Thomas Appleton, Chief Engineer Copper Range Railroad:—In designing shops, roundhouses, freighthouses and buildings of that class, it might be well to pay more attention to the methods of slow-burning construction, commonly known as "mill construction." Very often we find beams, rafters, purlines and jack-rafters, built one on top of the other, presenting a great many surfaces for fire to attack, and the pieces are so small in cross-section that a small amount of burning will weaken them so that they give way. In mill construction, a smaller number of large timbers is used, with plank instead of boards for sheeting, so that the fire risk is greatly reduced.

In regard to railroad architecture, it seems to me that the most important consideration in designing a station is to get convenience for the uses of the railroad and its patrons, as required by the business of the road at the point in question. After planning the necessary rooms, offices, etc., there is no reason why the building should have an ugly appearance. It is well to have some appropriate ornamentation, but the decoration should be subordinate to the convenience and economy of construction. It is not necessary that all buildings for a given purpose should look alike. The word "standard" is sometimes overworked. There might well be some variety in the exterior appearance of railroad stations.

Mr. H. G. Kelley, Chief Engineer Minneapolis & St. Louis:—As all buildings are used principally by departments other than the maintenance-of-way department, I would suggest that in the consideration and presentation of types by the Committee, due weight should be given to the experience and opinion of the departments using the buildings. For instance, in the case of freight stations, we should have the opinion, not only of the transportation department, but of the freight department; the same with passenger buildings, and with motive-power buildings. In other words, that due weight should be given to the opinions of the members of the department who use the buildings and who know the necessities of the design.

Mr. D. W. Lum, Assistant General Superintendent Maintenance Southern Railway:—The question has taken a turn that

I do not quite understand, and I am asking for information. There are many points upon which many of us may need the advice of those who perhaps have had experience in some particular line. I do not quite understand how we may obtain the benefit of the experience of all the members of the Association unless we bring the subjects to a vote, or obtain an expression from each individual. The Committee may consider a subject, such as has been referred to, and the chairman, after consulting with the members of the Committee, will present a type, not a standard, and it is barely possible that the Committee is not quite able to arrive at the correct solution of the question. It is barely possible that there are other members in the Association who might contribute something and influence the adoption of the type. How are we to arrive at the opinion of the Association as a whole if we only accept the Committee's report, and take no further action in the way of indorsing or rejecting it as an organization?

I was very much interested in a certain subject a short time ago, and sent for the proceedings of a certain association and read them very carefully, but I did not learn what the sense of the whole organization was. If we can arrive at that understanding in our meetings, then we may present the ruling type—that is, the type of the whole organization.

The President:—In answer to Mr. Lum's remark, I might say that the idea that the Board of Direction had in mind in reference to that was this: That after we got a little farther along, and we have derived more information from the reports of our various committees, that then the time will come for us to take action as an Association and determine the policy of the Association, and formulate the conclusions of the Association; that the idea of this first meeting was simply to have an interchange of views between the different committees and the individual members of the Association. If, at the close of the discussion of all the reports, it is thought wise by the members of the Association, or any of them, to make a motion or pass a resolution outlining the sense of the Association as to how the committee-work should be handled, or what the policy of the Association should be in reference to the consideration of the work, then it will be the proper thing to do; but it was not

our idea to take action of that kind until we had heard the reports of all the committees and they had all been discussed. You can very well see that without that our work must consist, first, in the acquisition of knowledge; second, in the assimilation of that knowledge, and, third, in the formulation of our conclusions from it.

If there are no further remarks we will consider the usual motion passed in reference to this Committee, and excuse them temporarily.

The Committee on Masonry will please come forward.

Mr. W. L. Breckinridge, Chief Engineer Chicago, Burlington & Quincy, chairman of the Committee on Masonry, presented the following report:

REPORT OF COMMITTEE VIII.—ON MASONRY.

To the American Railway Engineering and Maintenance-of-Way Association:

The subject of railroad masonry, differing from others coming under the consideration of the Association in being less general and influenced by local conditions, can only be treated specifically when applied to the needs of a limited territory. For this reason I should have, perhaps, consulted with the members of the Committee to obtain their views, instead of submitting an individual opinion, but not having the opportunity to do so, I will state the manner in which I think it should be taken up.

The outline as recommended, as furnished by the Society, is satisfactory, and will probably be followed. I suppose it was the intention to include material of construction as well as design and practice, and therefore I would change the heading of paragraph six from "Concrete Masonry" to "Materials." The question of materials being now in a state of transition, needs much consideration. Brick and concrete rank equally with stone, especially in parts of the country where the natural product is not near at hand, or of an inferior quality. To include materials will permit covering important preparatory ground, aside from design and construction, giving an opportunity to define the various classifications; also to obtain a uniformity of descriptive terms and to prepare standard specifications for different localities.

The subdivision of design and practice, as outlined, I would follow, except under the head of culverts; paragraph three should include four and five, subdividing it into masonry, iron pipe and wood. It may be advisable to add other general masonry construction-work required in railroad practice.

In preparing a report for the next meeting I had in mind the recommendation in Circular No. 8, not to endeavor to cover the whole subject. I suggest that we should take up the most important questions

of the day, which would be of greatest value and immediate benefit to ourselves and the railroad companies, and I expect to ascertain from members of the Association on what points information is desired.

The question that first occurs to me is about concrete specifications and practice. The company that I represent has gone into this work on a large scale. We have followed certain general lines in the construction, but have not prepared any specifications that might be called standard. Cast-iron pipe is another item in our bills of material. The high price may limit its use, and there may be something that can be used as a substitute.

Other subjects will be taken up as the Association requests, and considered in order of their importance. This is in line with paragraph three of Circular No. 8, and is my view of the manner in which we should proceed.

The recommended subdivisions would be tabulated as follows:

Masonry: Materials—stone, concrete, brick.

Design and Construction: Bridge—arch.

Culverts and Small Waterways: Masonry, iron, wood.

W. L. BRECKINRIDGE, Chief Engineer Chicago, Burlington & Quincy, Chicago, Chairman;

E. P. DAWLEY, Division Engineer New York, New Haven & Hartford, Boston, Vice-Chairman;

WILLIAM HOOD, Chief Engineer Southern Pacific Company, San Francisco, Cal.;

H. G. KELLEY, Chief Engineer Minneapolis & St. Louis, Minneapolis, Minn.;

W. E. HOYT, Consulting Engineer, Rochester, N. Y.;

F. S. STEVENS, Division Engineer Philadelphia & Reading, Reading, Pa.;

C. F. W. FELT, Chief Engineer Gulf, Colorado & Santa Fe, Galveston, Texas;

B. T. FENDALL, City Engineer, Baltimore, Md.;

F. M. BISBEE, Chief Engineer St. Louis & San Francisco, Springfield, Mo.;

Committee.

The President:—I think that one idea the Committee ought to consider is that of definition. It was not very long ago that the road I am connected with was interested in a piece of construction-work in which they were required by a city ordinance to construct a wall of masonry, and the question was whether concrete was masonry, whether brickwork was masonry, or whether masonry, in order to define it, should be called stone-masonry, brick-masonry or concrete-masonry.

I believe the same question came up at one time in reference to the legality of the bridge bonds of a bridge near New York City, in which a trust company did not want to take the

bonds because the company proposed to construct the piers of concrete, when the act under which the bridge was to be constructed specified that they should be of masonry. I simply throw this out as a suggestion in the discussion on this Committee report.

Mr. A. Torrey, Chief Engineer Michigan Central:—I believe the Constitution provides that we do not want to enter into the discussion of patented articles, and I would like to ask how far that principle can be observed. Of course, there are several kinds of patents that may prove very useful. That may hardly apply to masonry, perhaps, but the thought occurred to me how far the Committee intend to go in the investigation of any patents to be presented to the Association.

The President:—I think that is a matter for the Association to decide. I do not see how we can avoid the consideration of patented articles.

I do not think, speaking simply as an individual, that we ought to be restricted, whether an article or process is patented or not, provided it has merit.

There is one line of investigation that ought to be gone into by the Committee, and that is, in the first place, the economy of masonry and permanent structures of masonry, as against temporary structures; and, secondly, the relative economy of different forms of masonry, such as stone or concrete, or brick, and so on in relation to localities. In some parts of our country different forms of stone masonry are more economical; in other parts concrete is more economical. But the question should be considered, it seems to me, from the standpoint of economy.

Mr. C. E. Lindsay, Roadmaster Southern Railway:—The question of the proper size of culverts for a given drainage area, or a given topographical condition, is one that could well be studied. I think the text-books even are not very clear on the subject.

Mr. R. C. Barnard, Engineer Maintenance-of-Way Pennsylvania Lines West:—There is one thing that I think should be considered in connection with this report, which will apply with equal force to the work of the other committees, and that is the matter of submission to the Association of plans for proposed standards. The members of each committee can easily prepare plans for their own use, but to receive the sanction of the Association they should be examined by each member of it,

so that an intelligent opinion can be had of the subject under discussion before the members are called upon to vote their approval of it. If this is not done before the regular meetings of the Association, a great deal of time will be consumed at the meeting going over the plans in detail. I ask for information as to how it is proposed to handle this matter.

The President:—It has been the policy of the Board in reference to this meeting, and for future meetings of the Association—unless that is modified by some action which the Association may take a little later on—to have these reports sent in far enough ahead so that they can be printed and distributed among the members, in order that you may have a chance to carefully consider the points you want to raise long enough before the meeting so they can be well considered. I would like to remark here that a little later on in the order of our business, after we are through the consideration of these reports of the standing committees, and when we come to the order of New Business, it will then be proper for any member of the Association to bring any motion or introduce any resolution that he may see fit in regard to the policy of the Association-work.

Mr. S. P. Hutchinson, Asst. Gen. Agent Pennsylvania Railroad:—Under the head of culverts and small waterways I think it is worthy the attention of the Committee to look into the subject of the best distribution of the area that has been decided on for the stone-arched culvert. It is generally conceded that a low, wide opening will carry a stream better than a high, narrow one, and in the work I was on we found that with a very slight additional expenditure of money we got better openings by building segmental arches, with low bench-walls, rather than semi-circular arches with higher bench-walls.

The President:—We have a gentleman here who has a very long line of railroad in a very cold country, and where masonry has to stand up against frost more than anywhere else, and that is Mr. Peterson, of the Canadian Pacific.

Mr. P. A. Peterson, Chief Engineer Canadian Pacific:—In recent years we have built on the line of the Canadian Pacific Railway a great many masonry arches, retaining walls, etc. We find that there is great economy in building flat segmental arches, making them as wide as necessary and only as high

as is required to pass the stream, floating logs, stumps, etc., and in every case where we are preparing to double-track our line, we have put in arches of rubble masonry up to 60-foot spans with great economy, compared with the cost of abutments and steel girders. This kind of work, laid in the best Portland cement, costs about $6 a yard, and this we find is cheaper than concrete, as it takes much less cement, which becomes very expensive when it has to be hauled from fifteen hundred to two thousand miles.

Where our line runs along the Fraser River, we have walls one hundred feet high and large arches built of rubble masonry, using as large stones as can be conveniently obtained, and filling in between the interstices with still smaller stones mixed with Portland-cement mortar and very small stones, so as to make a thoroughly solid mass. We have found that this method, when intelligently carried out, makes the cheapest masonry, as less than one-half of the cement is used in this that is required for ordinary masonry or for concrete. Intelligent Italians, experienced in building roads in Italy, have been found to do this work cheaper than any other class of labor. The only cut stone used in this character of work is the bottom bed of the coping and the outer rings of the arches, and when the work is carefully pointed and the coping neatly pitched, it looks, in my opinion, quite as well as the best cut-stone work, and, in most places, very much better, as it is more in harmony with surroundings and shows evidence of economy.

In many cases we have used cedar in the construction of small box culverts. We find that cedar grown in British Columbia has a life of nearly two hundred years. I have in my office samples of sound cedar cut from a log found in Vancouver Park, Vancouver, British Columbia, which has growing over it a spruce measuring thirteen feet six inches in circumference, twelve feet six inches above the ground. Adjacent trees that have been cut down of the same dimensions as this spruce show 192 rings; so this cedar, from which the sound samples were taken, must have been lying in its present position more than 192 years.

Mr. W. E. Dauchy, Chief Engineer Chicago, Rock Island & Pacific:—In speaking of the subject of using stones imbedded in concrete brings out the question of the desirability of the

homogeneousness of concrete work. We are all more or less getting into concrete, and I think the question of using the same character of material all the way through should be considered. Now, I think it is frequently the practice to use different kinds of cement in the same structure, facing with Portland cement, perhaps, and using a backing of cheaper cement. There is also the question of imbedding larger rock in concrete—whether it is a desirable practice to carry out.

Mr. Hunter McDonald, Chief Engineer Nashville, Chattanooga & St. Louis:—There is another question I would like to submit to the Committee for consideration, and that is the load that goes on a culvert from an embankment. In determining the kind of foundation, which should be established, and also the size of the walls, it becomes necessary to determine the load that that culvert is to carry. I find a great difference of opinion as to the manner in which the load is transmitted to the culvert by the embankment, and also the rolling load, and I would like very much to have the Committee consider that point and submit it to the Association for further discussion.

Mr. W. G. Curtis, Engineer Maintenance-of-Way Southern Pacific:—In regard to the use of large stone in concrete, I have been familiar with that practice for a number of years. We have practiced that and we have had no failure. It is our practice to build masonry in large masses with the concrete, because, as a rule, it is a cheaper form of structure. It is our rule, and our printed specifications require large pieces of stone to be incorporated in the mass, care being taken that these large stones be perfectly sound, and, good cement used, in general, we have seen no reasons why we should take these large sound stones and break them up into small pieces, merely to cement them together again.

Mr. Dauchy:—Perhaps I stated too generally what my idea was. I have followed the practice the gentleman cites to a certain extent, but I think if we could have some experiments to show the strength of different characters of concrete, where it is homogeneous and where it is not, and get the relative value and strength of material in that way, the information would be of great value.

The President:—If there is no further discussion, we will excuse the Committee on the usual conditions.

As the Governor of North Carolina said to the Governor of South Carolina, "It is a long time between drinks"—we will call on the Committee on Water Service.

I have the pleasure, gentlemen, of introducing Mr. W. E. Dauchy, the chairman of this Committee.

Mr. Dauchy presented the following report:

REPORT OF COMMITTEE XIII.—ON WATER SERVICE.

To the American Railway Engineering and Maintenance-of-Way Association:

The amount of water used by railroads of the United States during any year is enormous. Estimated in dollars and cents, it represents many millions of dollars. Just how many it is difficult to say, as the systems of accounting now in vogue on most roads distribute this expenditure among the various accounts and do not show it in figures by itself.

The cost per gallon of the water used by the different roads would, perhaps, show a larger variation in figures than the cost of any other article consumed in the operation of railroads. If the cost per gallon of the water furnished by each individual plant of all the roads in the country could be obtained, it would, no doubt, furnish a very interesting study.

Under the head of "Water Service" the Board of Direction has outlined the subject under three general heads:

First—The source of supply.

Second—Method of pumping and supply.

Third—Character of water.

In outlining the work of the Committee, these three divisions seem to be the natural ones to follow, and each will be considered briefly.

First—The source of supply.

This is a comparatively simple question when the character of the country is such that there is an abundance of water to be had, and the only things to be considered in such favored localities are the selection of the water best adapted to boiler use, and the cheapest method of obtaining it. But the rapidity with which this question becomes a complex one is, perhaps, best appreciated by those of our members who have had to deal with the arid and semi-arid regions of the West and Southwest.

In some portions of these arid districts the question of obtaining suitable water at any cost is very much of a problem. In other portions there is water to be had at a reasonable cost, if one has the good fortune to find it; but in the search for it the element of chance sometimes enters more largely than engineering skill. As an illustration of what is meant I will cite two instances.

The first occurred in Eastern Colorado, where, in selecting the location of a water station, the only apparent source of supply for a distance of twenty miles along the line of road was a small spring, situ-

ated about a mile from the track, on a slope which inclined toward the railroad. The spring furnished but a small supply of water, which soon lost itself in the sand in the bottom of a dry stream, which crossed the track where the water station was located. A well was dug alongside the stream and so located that it caught all of the drainage from the stream due to rainfall. For several years this supply was made to answer the requirements by careful usage, but at times it failed entirely. In the meantime, test wells had been put down at all promising places in the vicinity, without finding any water, until one day a test well was dug upon the top of a ridge, about three hundred feet from where the original well was located, when a vein was struck which has furnished an abundant supply ever since.

The second case occurred in the Indian Territory, at a division station. There was plenty of water to be had in a flowing stream, but it was of a very bad quality for boiler uses. Numerous wells had been dug and drilled in the vicinity, varying in depth from 50 to 900 feet. In the deep well a fine flow of salt water was obtained, but the other holes furnished little or no water. But the Superintendent of Water Service, like the persistent mole, kept burrowing in the ground until he was rewarded by striking a fine flow of good water in a gravel strata, eight feet thick, that was situated in the very midst of his other futile attempts.

I cite these instances merely to show that a large amount of money might have been saved if there had been some means of knowing where to look for underground water. Now, I do not know that any amount of investigation would entirely remove this element of chance in the search for underground water, but I think that the work of the Committee under this division of the subject should be largely devoted to obtaining all of the information possible with regard to the location of underground water and its relations to different soils and different strata of rock. This would apply, perhaps, more particularly to deep wells.

As a rule, it is a difficult matter to find out much about a drilled well, except as to the amount and character of the water that it furnishes. In a majority of cases no record is kept of the different strata that the well has penetrated, and if, as is often the case, the well has turned out to be a dry hole, its existence is soon forgotten.

If a systematic record could be kept of all deep wells that are put down, showing the location, general character of the country, the strata penetrated, and if water is obtained, in what stratum, or between what strata it is found, a record of that fact made, the information obtained in that way would be of value as a guide to future operations.

For instance, it is one of the most uncertain things to determine, in the search for water in deep wells, when to stop drilling. Now, if the records kept in a large number of wells should show that under certain strata of rock, or combination of strata, no water had been found, when the drill had reached these same strata, it would be policy to stop; or if in a number of wells salt water had been found, and in no case had good water been found under the salt water, the reaching of salt water would be an indication of the uselessness of a further expenditure of money upon that hole.

I think this question as to when to stop drilling is one of the hardest things to decide in the putting down of deep wells. A large amount of money has perhaps been spent with no favorable result, and the question is whether to keep on a little longer, in the hope of obtaining good water, or to stop short; and this continual keeping-on finally amounts to a large sum of money, so that if we could have the advantage of the combined experience of all, I have no doubt it would be the means of saving large sums of money in useless drilling. But this is merely the negative side of the question.

If the same records of holes drilled could give us some indication as to where, in the general configuration of the country, a search for water was likely to be successful, still more favorable results would be accomplished.

Almost every person who has had experience in putting down wells has a theory of his own as to where water is to be found, and these theories vary in value from that of the man who believes in the divining power of a witch-hazel bough to that of the engineer who bases his theory upon accurate records of a large number of both successful and unsuccessful holes, and probably the experience of each would add something to the value of the combined knowledge, and I think it should be the effort of the Committee to get the result of this combined experience in the shape of records of both past and future work.

It frequently happens that the supply of water in drilled wells may be increased by the use of explosives to open the seams of the rock at the bottom of the well. Information as to the kind of explosives to use and the best method of handling them would be of use.

In open wells the amount of water to be obtained may sometimes be increased by running tunnels out in different directions from the bottom of the well, or by connecting two or more wells together by tunnels. This should be considered, and, in general, the different methods of drilling and casing drilled wells and of sinking open wells should be investigated.

Second—Method of pumping and supply.

Under this head should be considered the location of water stations.

In selecting such locations the questions of convenience, minimum delay, safety of trains and economy should be considered.

On very busy lines facilities for taking water should be located at regular stations, while on lines where traffic is light it is sometimes advisable to locate tanks between stations as a matter of economy; but whenever they are so located the question of grades and of protection to trains should be considered.

As to the different methods of supplying water directly from tanks, or through water columns, or track tanks, the desirability of each method should be considered, in connection with the amount of traffic, the minimum delay to trains and the question of economy. The comparative cost of each method should be determined as nearly as possible.

Under the head of pumping, I think a thorough investigation of the

circumstances where windmills can be used to advantage should be made, and also a complete investigation of the relative cost of the use of gasoline engines for pumping purposes, as compared with steam-pumps.

A great many gasoline pumping plants have been established during the past few years, but owing to the rapid rise in the price of gasoline some of them have been discontinued and pumping by steam substituted.

Steam-pumping machinery has reached such a degree of efficiency that I do not know that anything need be said with reference to that.

Third—Character of water.

I do not know that much need be said at the present time under this heading. We all know what bad water is, and that a great deal of it is used daily by many roads in the country. Water that the chemist pronounces totally unfit or very bad for boiler use is nevertheless used for the want of something better, and, in a way, serves its purpose in getting trains over the road, probably at a large expenditure for new flues and boiler repairs.

It would be interesting to know, if the figures were obtainable, just the amount of money that is expended upon boiler renewals and repairs that is due to poor water, but after we had obtained the figures I do not know that they would be of any great service otherwise than to satisfy our curiosity, or, perhaps, be an incentive to the inventor of boiler compounds, as, in most cases, poor water is used because no better is to be obtained.

There are, no doubt, many instances where poor water is used because of the necessity of a large expenditure of money to obtain good water, but each case of that kind must be considered upon its merits, being merely a comparison of the saving in boiler repairs, with the annual interest charge upon the amount necessary to be expended to obtain good water.

An investigation of the efficiency and cost of compounds to counteract the impurities of water would be very beneficial, and the investigation should include the different kinds of chemical filters.

Under this division of the subject might also be considered the question of repeatedly using a portion of the water that is used around roundhouses and shops. At division stations a larger amount of water is usually used for washing out boilers and other purposes than is used for making steam, and where water is scarce, a large saving can be effected by constructing cisterns to catch the water used for boiler washing, and the same water can be used again and again for that purpose. Sometimes it is desirable to run this water through a filter; at other times this may not be necessary.

There are probably other questions of interest in connection with water service that the Committee will find it profitable to investigate that have not been touched upon, and I have merely outlined a few of what have seemed to me the most important.

W. E. DAUCHY, Chief Engineer Chicago, Rock Island & Pacific, Chicago, Chairman;

D. WILLARD, Assistant General Manager Baltimore & Ohio, Baltimore, Vice-Chairman;
H. C. DRAPER, Consulting Engineer Chicago & Alton, Chicago;
O. D. RICHARDS, Chief Engineer Ann Arbor Railroad, Toledo, Ohio;
W. B. STOREY, Jr., Engineer and General Superintendent San Francisco & San Joaquin Valley, San Francisco;
G. H. WEBSTER, Engineer Maintenance-of-Way Manitoba & Northwestern, Winnipeg, Man.;
SAMUEL ROCKWELL, Principal Assistant Engineer Lake Shore & Michigan Southern Railway, Cleveland, Ohio;

Committee.

The President:—Water supply is getting to be more and more important for us all. When we used to run small and light trains it was not a very serious matter, but for years our tonnage has been increasing and water consumption increases. On roads that up to a few years ago there was little trouble, the water supply now has become a very serious question. The subject is now open for discussion.

Mr. T. F. Whittelsey, General Superintendent Toledo & Ohio Central:—In various parts of the country water supply is very much impaired by operations of mining and the production of oil, and a large amount of salt water is pumped into streams, deteriorating the natural water to a large extent. I think it would be well for the Committee to consider the practicability and cost of securing for locomotives practically pure water by some system of filtration. I think we will have no permanent results in preventing scale on the boilers until we put nothing but pure water into the engine tanks.

Mr. W. G. Curtis, Engineer Maintenance-of-Way Southern Pacific:—The Committee has presented us with a very excellent report, and I can think of nothing in the way of suggestion in addition to the lines of procedure that they have marked out for themselves. On the line in which I am interested, the water problem is a serious one. We run through a large extent of country—in some places below the sea level, and at other places having mountain elevation. We have no method of telling where underground water is to be found, and find it more or less by accident. We find a good well at one place, a long distance away we will find another, and, then, boring at short intervals, we endeavor to locate intermediate wells.

Years ago, on a wagon road across a desert—a supposed desert—water had to be hauled for the supply of a stage sta-

tion. When our railroad was under construction there, and water was being hauled to the end of the track and beyond the end of the track in carts for the supply of the Chinese laborers, the riding boss came along one day and found a hole in the ground full of water. He immediately got off and whipped the Chinaman nearest to the hole, and fortunately after awhile the Chinaman recovered sufficiently to say that that was natural water and he had developed it himself. This surface water was found unsuitable for steam uses and we sunk some deep wells at random, finally getting a flowing or artesian well that gave 80,000 gallons a day. We sunk one well as deep as 2,600 feet, and finally losing the boring tools in the bottom, abandoned it—a dry hole. Experience in Arizona and New Mexico, I think, has disproved all our reasoning as to where water could be found, and about all the good wells we have were found by accident. We bored one well five hundred feet deep in a desert depression below the sea level which discharges an excellent quality of water over the top of an ordinary tank.

We are treating a good many of our waters by scientific method, and we have got a good deal of good water by threatening to treat bad water. When we threaten to treat bad water, our division people go to work and find good wells. We don't believe much in mysterious panaceas for treating waters. They are a good deal like the man down in Texas who gave pills to everybody who was sick; no matter what was the trouble, he always gave them the same pills. But in the matter of finding water, we have tried many methods. We have tried the witch-hazel man and the man with the mysterious electrical contrivance, and other things, until we have come to the conclusion that the finding of underground water is to a great extent a matter of chance.

Mr. C. A. Wilson, Chief Engineer Cincinnati, Hamilton & Dayton:—I think that one of the most important features in this water supply is the question of water treatment. From some investigations I have recently made I have come to the same conclusion that Mr. Whittelsey has—that wherever bad water existed, a good surface supply could not be obtained. Where a good surface supply cannot be obtained, I believe that there is no question but that the water treatment would amply

repay for its cost in the washing of the boilers alone, which now, in my opinion, costs more than it costs to treat the water.

I want to call the attention of the members to the report of the Master Mechanics' Association on this subject for the past year—1899—which many of us might find to be of use.

The President:—There is one thing in the water service that has not been touched upon in the subhead under the committee-work, and that is the question of organization—that is, how the water service should be handled on the different railways. I believe it is the custom on some systems to have that under the maintenance-of-way department, and with others to have it under the machinery department, and I think it is a matter that the Committee ought to consider.

Mr. Dauchy:—Wouldn't that come under the work of the Committee on Organization, if there is such a committee?

The President:—Yes, there is such a committee. Still, I think that each of the committees should take up the question of organization in so far as it affects its own committee-work, in addition to its general treatment by the Organization Committee. It would, of course, be the proper thing for the Committee on Organization to keep in touch with the committees on the various other subjects and get their ideas as to how the organization of their particular work should be treated.

On the Illinois Central Railroad the water supply is handled primarily by the division officers, the division superintendents being considered general managers, in fact, of their division. In order, however, to have the water supply of the entire system properly handled and the different divisions supplemented in their efforts, the matter is under the Chief Engineer, who has charge of maintenance-of-way matters, and he has a staff officer, whom we call the general foreman of water supply, whose business it is to study the water question of the entire system, and to confer, advise and consult with the division officers as to the problems on their respective divisions with regard to the water supply, quantity and quality, and the proper machinery to be used, etc.

This general foreman of water supply is also equipped with a diamond drill and with various mechanisms for deep-well experiments, and the sinking of deep wells on the entire system is under his control. This outfit is kept moving from one place

to another, and when there is no actual work for it, it is used for experimental purposes.

Mr. W. D. Pence, Professor of Civil Engineering, Purdue University:—The question of the tank itself would, it seems to me, come more properly under the head of water supply than under that of structure. I see in the outline of the report that the water tank is mentioned under the head of building or structure.

Would it not be well for this Committee on Water Supply to discuss the material of which the tank is made? This is a very live topic in some portions of the country; for example, a white-pine tank, which would give excellent service in a northern climate, would have a very much shorter life in the South.

Likewise the question of the use of metal tanks. That question is receiving a great deal of interest, and with the metal market in anything like a normal condition, the use of metal tanks would be the cheapest.

I would like to hear the experience of some of the roads on which the metal tanks have been used—I think the Rock Island has used them.

Mr. Dauchy:—I can say that we have put up quite a good many metal tanks during the past three or four years, and we considered them a great economy up to the rise in the price of steel, and I don't know but they are at the present time.

Then there is another question in regard to the metal tank. You can usually get a tank of larger capacity, and that very frequently saves the cost of the tank in the pumping service. Take a station where a large amount of water is usually consumed, it generally has to have both a day and a night pumper, and we have in a number of instances put up these metal tanks, or standpipes, as they are sometimes called, and we have saved the cost of one pumper—about six hundred dollars a year.

The President:—There are a great many of these subjects where one committee or another can discuss it, and in those cases both committees should look into it, and should communicate with the committee that has the same subject to consider, so that there will be some harmony among them.

Mr. C. E. Lindsay, Roadmaster Southern Railway:—The report speaks particularly about going down for water. I hope they will not forget to go up for it and appreciate the value of

the gravity supply. There is, too, to be considered the economical ratio of the value of the land covered, and the cost of the dam to the cost of the water from a gravity supply. In our youth we perhaps have sung the virtues of the Derby ram, and I hope the Committee will investigate the hydraulic ram and see if there are any virtues in it they may extol.

The President:—It is now five minutes to two o'clock. I am very sorry to stop this interesting discussion. Out of the fourteen committees we have full reports from all but three, and two of these three we expect to have to-morrow, so that we will have eight committees to hear from at that time. As near as we can judge, it will require about four hours' continuous work, and it is a question whether we should hold one continuous session, or whether we should convene at ten o'clock, as usual, and have a recess, say, from 12:30 to 1 o'clock, and have a session in the afternoon, closing that session in time for preparation for the banquet.

I would like to hear some discussion from members of the Association as to what we should do in reference to the programme to-morrow, as to whether we should hold one continuous session or two sessions.

Mr. Sullivan:—I think that question can safely be left until to-morrow. If you are making good progress in the consideration of the reports, and it is found that by remaining an hour longer the business can be closed up at one session, I believe that to be the most desirable arrangement to make; but if the work is consuming time to such an extent that one session is impracticable, that question could be determined at the usual time for taking a recess, and then arrangements could be made for two sessions, with a recess for lunch.

The President:—If there is no objection, we will handle the matter as suggested. I think Mr. Sullivan's idea is a good one, but I would like to have you come to-morrow prepared to hold a continued session, or to give up your time in the afternoon, if possible, to our Association-work.

The interest and importance of these reports seem to me to be such that we should not adjourn our annual meeting until we have gone through them all thoroughly. At our next meeting we will be better prepared to determine the length of time it will take to consider these matters.

To-morrow is the annual election of officers, and the announcement of the result is the last thing on our programme. I will appoint C. A. Wilson, E. C. Macy, and C. Dougherty as tellers. The polls are closed at this session. These gentlemen will call upon the Secretary, who will turn the ballots over to them, and they will count them and have their report ready at the close of the meeting to-morrow.

Has the Entertainment Committee anything to announce?

Mr. C. W. Hotchkiss, of the Entertainment Committee:—The train will be back here at 7 o'clock to-night. It will leave at 2:30, and we will have about thirty minutes to adjourn and get to the Dearborn-Street Station.

On motion, the meeting adjourned, to meet Thursday at 10 o'clock.

THURSDAY, MARCH 15, 1900.

MORNING SESSION.

The President:—At the meeting of the Board of Direction last night the transactions of the Association up to the close of this First Annual Meeting were ordered printed by the Publication Committee. It will make a book about the size of these leaflets, about an inch and a quarter to an inch and a half thick. It will be quite a volume and will be ready for distribution among the members about the first of June. The members will be notified by the Secretary that they can have their choice of those transactions bound in paper without any expense, or bound in cloth or half-morocco at the cost of binding.

In those transactions will be printed a list of charter members, as revised to date. The former list, printed in December, was found incomplete. Some members whose application came in under the order of the Board of Direction as charter members did not reach the Secretary until after that date, and it was finally decided to revise that list and to print as charter members all of the members that have been admitted to the Association up to this, the First Annual Meeting, which we have chosen to regard as our real first meeting.

At the noon recess—whether it be long or short—the chairmen of the various committees would like to have short sessions of their committees. Several of these chairmen, or vice-chairmen, have spoken to me and stated they were not familiar enough with the membership of their committee to be certain of finding them, and it was thought easier for the committees to find their chairmen or vice-chairmen; so you will kindly group yourselves at the noon recess, or immediately at the close of the session, so the chairmen or vice-chairmen can have at least a word with their committees before they go. I think you will find it of advantage in your committee-work.

The Secretary:—In regard to the banquet to-night, it is necessary, in order that each member may have his proper place assigned at the table, that cards be secured in the ante-room here

during the recess. The tickets will be ready for you there, and you will pay for them at the time you get them. The ticket has a number corresponding to the seat at the table. If any of you fail to get tickets here this morning, or during the recess, you can get them at the Victoria Hotel between three and six o'clock this afternoon.

The President:—At the close of our meeting yesterday we were so anxious not to delay the Santa Fe train that we left the Committee on Water Supply, as you might say, hanging in the air. We did not receive their report, and we did not thank them, and I know we fully appreciate Mr. Dauchy's report and the work of the Committee. If there is no objection on the part of the Association, the Committee can consider themselves thanked.

We have a great deal of work, gentlemen, before us to-day, and I hope you will excuse me if we lay aside all parliamentary frills and get down to business and carry it through energetically.

Mr. Dauchy:—We appreciate the thanks of the Association very much. We thought we did not have a dry subject, by any means, and are glad to be treated like the rest of the committees.

The President:—The Committee on Ties will please come forward.

The Secretary read the names of the Committee.

The President:—I beg that Committee's pardon. I presumed the Committee was ready. We will call another committee—the Committee on Interlocking.

The Secretary then called the Committee, who came forward.

The President:—I take pleasure in introducing Mr. Miles, Signal Engineer of the Michigan Central Railroad, who will read his report.

Mr. H. D. Miles, chairman of the Committee, submitted the following report:

REPORT OF COMMITTEE X.—ON SIGNALING AND INTERLOCKING PLANTS.

To the American Railway Engineering and Maintenance-of-Way Association:

The Committee on Signaling herewith presents a brief outline of the topics to be treated under the headings given in the pamphlet issued by the Association.

It has not included most of those subjects which have been considered and acted upon by the American Railway Association. It would not seem necessary or advisable to treat of exclusively operating questions in relation to signaling, when those questions have been so fully considered by a special committee of the American Railway Association and acted upon by that association.

The Committee assumes that the American Railway Engineering and Maintenance-of-Way Association will deal with engineering and maintenance matters principally, and consider operating questions only in so far as they affect, or are affected, by the engineering and maintenance problems. This is a question, however, which must be decided by the Association, and the Committee therefore desires to be instructed.

As the membership of the Committee is small, and each general subject will require a large amount of work in order to be treated properly, it has been deemed advisable to consider but one subject at a time, and as the large majority of interlocking plants are jointly owned, operated and controlled by two or more companies, it is evidently the subject which should be considered first. The Signal Committee should consult with the Committee on Track in regard to the design of switch-rods, the spacing of such rods, the bracing of stock rails, the use of gauge plates, etc., and should consult with the Yard and Terminal Committee regarding the location of switches, frogs and connections for convenient and safe manipulation when handled by interlocking plants.

It is proposed to standardize, as far as possible, the specifications regarding the construction of mechanical interlocking plants, and the designs of material which enter into the construction of such plants. It is also proposed to standardize, as far as possible, the specifications regarding the design of block and train-order signals, and the specifications covering the installation of automatic block signals. The requirements necessary in the matter of circuit designs, which are employed in automatic block signaling in order to insure safe operation, will be fully considered, as will also the question of proper indications to be given of the position of interlocked switches and signals which are operated in connection with power plants.

1. Signals:
   - (*a*) Train-order Signals:
     - Most desirable type.
     - Usual location.
     - Drawings, showing standard design of post and fittings and operating levers and connections.
   - (*b*) Distant Signals:
     - Their use as caution signals for train-order signals, station block signals, automatic block signals and interlocking high-speed home signals.
     - Most desirable forms.
     - Maximum and minimum distance from home signal.
     - Most desirable form of operating connections.

Drawings of standard design of posts and fittings for mechanically operated signals.

Circuit-controlling arrangement for those electrically operated.

(c) 1. Block Signals: Manually operated—telegraph communications between stations:

Most desirable form.

Usual location.

Drawings of standard design of post and fittings and operating levers and connections.

(c) 2. Block Signals: Manually operated and electrically controlled:

Most desirable form.

Usual location.

Drawings of standard designs of posts and fittings and operating levers and connections.

Description (and possibly drawings of circuits), giving requirements necessary for accurate information between operators and safe operation of signals.

Specifications governing construction.

(c) 3. Block Signals: Automatic:

Most desirable form.

Normal danger or normal clear system.

Distant signals, or overlaps, visible or audible switch indicators.

Protection against lightning troubles.

Designs of circuits to cover usual conditions at stations, yards and between stations both for single and double track, and location of signals to cover such usual conditions, taking into consideration grades, curves and volume of traffic.

Specifications governing construction.

2. Interlocking Plants:

Railway crossings and drawbridge protection, arrangement and location of derails, locks and signals.

Arrangement of tracks, and switch and frog connections, and the location of signals most suitable for the safe and rapid handling of traffic in yards.

Standard specifications regarding the quality and type of material to be used, the arrangement and location of facing point and bolt locks, and the requirements generally covering the construction of plants.

Drawings of standard designs of apparatus used in the construction of plants which are likely to be adopted as standard by a majority of roads.

Under what conditions are power plants desirable.

Desirability of electric locking and the question of a time release as a substitute.

3. Highway-crossing Signals:
   Gates.
   Drawings, showing design of gates and operating connections.
   Alarm bells.
   Most desirable types for the several conditions to be covered.
   Modes of operation.
   Lettering on sign for alarm bell.
   Specifications governing construction.
4. Miscellaneous questions:
   Flag-station signals.
   Fixed signals for protecting trains at isolated points.
   Signals connected with isolated switches.
   Colors for night signals.

H. D. MILES, Signal Engineer Michigan Central Railroad, Detroit, Mich., Chairman;
F. W. SCARBOROUGH, Engineer Bridges and Signals Chesapeake & Ohio, Richmond, Va., Vice-Chairman;
W. J. GILLINGHAM, Jr., Signal Engineer Illinois Central, Chicago;
J. S. HOBSON, Signal Engineer Atchison, Topeka & Santa Fe Railway, Topeka, Kan.;
A. H. SANFORD, Engineer Maintenance-of-Way Pennsylvania Lines West, Toledo, Ohio;

Committee.

After reading the report, Mr. Miles proceeded as follows:

Mr. Miles:—According to the present method of signaling in vogue in the United States and in the countries contiguous to it there are several types of signals used for the same purpose, and I therefore think the Association should endeavor to adopt, as far as possible, standard designs of signals for the various uses to which signals are put, and to have as few designs as possible.

The Committee will require a great deal of information from the several roads represented in this Association, and I would ask that the members of the Association aid the Committee as much as possible in obtaining plans, rules and general information regarding signaling in connection with the roads which they represent.

The President:—The question is now open. If any of you have anything to say on this subject, speak up, and let us get some action on it.

I am afraid, however, that we have made one mistake, in that we have probably the majority of our members who are conversant with interlocking signals on this Committee.

Mr. Richards, have you anything to say?

Mr. Richards indicated that he had nothing to say.

The President:—Mr. Hutchinson, have you anything to say?

Mr. S. P. Hutchinson, Asst. Gen. Agent Pennsylvania Railroad:—Mr. President, all I can say is that I believe the Committee has very thoroughly covered the ground to be looked into. Mr. Shober, here on my left, suggested one thing that it may be well to look into in connection with this subject, and that is, drawbridge signals. I don't see that in the list.

Mr. Miles:—I think you will find that is included in the report of this Committee.

Mr. Hutchinson:—Well, then, I don't think of anything I can say. The report seems to bring the subject out very fully and clearly to me.

The President:—Mr. Sullivan, can you throw any light on the question, or have you any questions you would like to ask the Committee?

Mr. Sullivan, General Superintendent Illinois Central:—I think the Committee's scheme is quite a complete one. There is one thing more, however, that might be considered, and that is the combination of audible and visible signals for use in tunnels or places where visible signs are likely to be obscured, so that the audible signals may serve to supplement the visible signals as an additional safeguard.

The scheme of the Committee is quite comprehensive, and there is very little to be said in addition to what they have submitted.

The President:—Mr. Dwight C. Morgan is here and is one of our guests, and he expects to be one of our members. He was Consulting Engineer of the Board of Railway Commissioners for the State of Illinois, and I think he could throw some light on the question, if he will.

Mr. Dwight C. Morgan, Engineer Maintenance-of-Way Chicago & Alton:—I think the scheme submitted by the Committee is a very complete one, and I do not believe I can offer any suggestions that would improve the plan presented.

What I wish to say in respect to interlocking is somewhat out of line so far as the report of this Committee is concerned, but it may come within the scope of this Association. As a

usual thing, the least item to be considered in equipping a grade crossing with interlocking is the first cost of installing the plant. Take, for example, a simple crossing requiring twelve working levers; the cost is approximately $225 per lever, or $2,700 completed and ready for operation. The cost of installation is unimportant; the real items for consideration are those of operation and maintenance, because in equipping a grade crossing with interlocking there has been established a fixed expense amounting to about $1,500 per annum, or five per cent interest on $30,000 represented capital. In many cases this sum of money is more than sufficient to separate the grade lines and establish an overhead and underneath crossing. The application of this principle can be applied only within certain well-defined limits wherein the true measure of economy has been determined from a thorough consideration of the question, but it is obvious that it becomes the duty of an engineer to weigh carefully every proposition which leads to increasing the fixed charges of a railway.

The President:—I think the remarks of Mr. Morgan are very pertinent to the general object of economy. Are there any further remarks on this subject?

I see very plainly, so far as this Committee is concerned, that the work is so technical, and that there are probably very few members who are familiar enough with the details of interlocking work to discuss it; but the report of this Committee is very exhaustive and complete, and the outline which they suggest in their report is very comprehensive and indicates a line along which they should do very efficient work.

I suppose you have all heard the story about the new Superintendent who went to a road down in Mississippi, I believe it was; he had his car on the rear end of his train, as usual, and he told his roadmaster that he wanted him to get a lot of blocks of wood and paint them red and put them on the rear platform. The roadmaster asked him: "What do you want those blocks for?" and he replied: "I want them to throw off whenever I see a low joint that needs attention." The roadmaster said: "If you will throw them off where we don't need to do any work you will save blocks and time and money."

Now, the application is this: Our time is very limited, and if we move to accept this report and thank the Committee, it will

take time, and I would suggest that we dispense with even that formality and let the committees consider themselves thanked, unless other action is taken. Gentlemen of the Committee, you are excused. The Committee on Ties will please come forward.

The Committee on Ties came forward, headed by their vice-chairman, Mr. G. W. Kittredge, Chief Engineer Cleveland, Cincinnati, Chicago & St. Louis Railway, in the absence of the chairman.

Mr. Kittredge:—Mr. Chairman and gentlemen, I am sorry that this report of your Standing Committee on Ties could not be presented by the chairman in person. In his absence I must present it to you in the best way that I can. It is a matter of regret also that our Committee is represented by such small numbers, but if you will bear in mind the statement about valuable packages not always being in large bundles, I will proceed with the report:

REPORT OF COMMITTEE III.—ON TIES.

To the American Railway Engineering and Maintenance-of-Way Association:

In compliance with a resolution of the Board of Direction, requesting the chairmen of the standing committees to prepare papers treating briefly of the subjects assigned them, I beg, as chairman of Committee III.—On Ties, to submit the following:

I think the subject of ties can be best studied from carefully-kept statistics. In all publications relating to either the preservation or uses of ties, one is struck by the absence of accurate statistical data. From past experiences I should say that, in looking after the interests confided to them, railway engineers and maintenance-of-way officers derive the greatest assistance from constant and close considerations of results attained on the lines of their neighbors and connections, as shown in statistics of operation. I would, therefore, most urgently recommend that blank forms be printed by the Association and sent out to all members, with a request that at least some of the data called for be furnished, if it be found impracticable to furnish all, believing that, after the first few years, the value of this information will be so patent and highly appreciated that little or no difficulty will be met with in procuring everything desired. Objections on the score of expense are perhaps to be expected, but it can be asserted with confidence, based on experience, that the amount of work necessary to fill these blanks from year to year is insignificant, indeed, incredibly so to anyone who has not tried it. As in all undertakings, the beginning will be the most difficult to accomplish, but, once having started, maintenance-of-way officers and engineers will find that the data can be added from year to year with the expenditure of very little time or money.

Statistics of Tie Renewals on.....Railroad. Year ending.....19.....

Division.	Miles of road operated.			Per mile of road.		Per cent of renewals to number in track.	Total number of ties renewed	Gross tonnage of rolling stock passing over track.		Maximum weight of		Wt. of rail per yard.	Percentage of main line tracks.				Average cost of ties at distributing point.		*Total cost of tie renewals.	
	First main track.	Additional main track.	All tracks including sidings.	Average number ties in track.	Number of ties renewed			Per mile first main track.	Per tie renewed	Locomotive and tender in tons.	Fully loaded fr'ght car in tons.		Curved	Tie plated	Ballasted	Laid with treated ties	Treated.	Untreated.	Per mile first main track.	Per mile of all tracks
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.
Total.....																				
Total, previous year....																				

*To include cost of cross and switch ties, tie plates and spike plugs, but not the labor of placing in track.
Use mileage in column 2 for computing averages in columns 9, 20.
Use mileage in column 4 for computing averages in columns 5, 6, 21.

Form No. 1, given above, is proposed. It gives in condensed form all information about ties that an operating officer could reasonably want. Additional information bearing on the life and comparative cost of ties of the various kinds of wood, treated as well as untreated, should be obtained on blank forms, when the work of the Committee is divided up. The footings by railroad systems of the columns of Form No. 1 should be tabulated annually and would furnish a mine of information nowhere else obtainable, constituting in itself the most instructive annual or progress report that the Committee on Ties could possibly present to the Association.

Together with this statistical statement I would suggest the rendition of other annual statements in the nature of progress reports, showing what is being done in the way of preserving ties, what results have already been obtained from the various methods, and what has been determined to be the average life of ties of various kinds of wood.

Some of the subjects to be handled by the Tie Committee can be pretty well exhausted with one thorough investigation, while others are of lasting interest, and, to be properly understood, should be studied over long periods of time, therefore requiring progress reports annually. In the first category we might place inspection, disposition of old ties, methods and general questions, while in the second category we might place the subjects of material, preservation and cost.

I think the chairman should supervise and direct the general work of the Committee and should prepare the annual progress reports. The vice-chairman should send out the blanks calling for general statistics, and should tabulate them for the consideration of the general Committee, forwarding them to the chairman at least sixty days before the annual convention of the Association. To the other members of the Committee should be given the investigation of the separate subjects assigned the Committee, each making a report to the chairman sixty days before the annual convention, the distribution of the subjects, of course, to be made by the chairman.

At least one annual meeting of the Committee should be held, preferably a few days before the annual convention, when the annual report, as prepared by the chairman, can be considered and voted on by the Committee before being submitted to the Association.

Respectfully submitted,

J. KRUTTSCHNITT, Vice-President and General Manager Southern Pacific, San Francisco, Chairman;

G. W. KITTREDGE, Chief Engineer Cleveland, Cincinnati, Chicago & St. Louis Railway, Cincinnati, Vice-Chairman;

J. J. FREY, President Florence & Cripple Creek Railroad, Denver, Colo.;

J. C. NELSON, Division Engineer New York Central & Hudson River Railroad, New York;

W. L. DARLING, Assistant Chief Engineer Northern Pacific, St. Paul, Minn.;

O. CHANUTE, Consulting Engineer, Chicago;

WILLIAM ARCHER, Principal Assistant Engineer Baltimore & Ohio Southwestern Railroad, Cincinnati, Ohio;
W. C. CUSHING, Engineer Maintenance-of-Way Pennsylvania Lines West, Pittsburg;
LEWIS KINGMAN, Chief Engineer Mexican Central Railway, Mexico, Mex.;

Committee.

Mr. Kittredge:—In addition to the report of the chairman, which I have read, I will say that the form submitted is submitted as a suggestion, as it is, in our opinion, much easier to criticise and get at what we want by offering something which can be attacked.

I was at one time in my career Engineer of Maintenance-of-Way of the Muskingum Valley division of the Pennsylvania Lines West of Pittsburg. At that particular time there was very little ballast on a large portion of the road. We had a great deal of old iron there, very few ties, and labor was scarce. I was going over the road one day with the supervisor—by-the-way, one of the best little supervisors I ever knew—John Ward. It was in the spring of the year, the weather was not favorable and the track was pretty rough, and I presume I had been making life a burden to him, until the limit of patience was reached. As we passed a section of track near Washington Courthouse, I said: "Well, John, you must do something about this track; it rides very bad, and I hear a great deal of criticism about it." "Yes," said John, "any d—n fool can criticise," and, bearing that in mind, we offer this as something that can be criticised. (Laughter.) We do not think the thing is in complete form, just as it possibly will be to send out, yet it is in some shape, so that it can be looked over and modified.

The President:—I don't suppose that Mr. Kittredge felt that you were all qualified to criticise. (Laughter.) But the subject is now open for discussion, and we would like to have a full criticism, whether you classify yourselves or not.

Mr. C. E. Lindsay, Roadmaster Southern Railway:—The Committee seem to confine themselves to the consideration of wood ties. Are we not to have any consideration of metal ties?

Mr. Kittredge:—I will say for the benefit of the member that if he will look at the subheads under the question of ties he will find that metal ties are especially mentioned there. That is found in the little pamphlet that has been distributed, and not

in this report. There are seven different subheads suggested in that report, and we did not think at this time it was important or necessary for us to refer to each one of them in detail.

Mr. Hutchinson, Asst. Gen. Agent Pennsylvania Railroad:—I notice that in a footnote, referring to total cost of renewals, it says: "To include cost of cross and switch-ties, tie-plates, and spike plugs, but not the labor of placing in track." I would like to say that on one division that I was on once we kept a very careful account of the actual proportion of track labor involved by the renewal of ties, and we found it had a great deal of bearing on the subject, and we also found that the following year—after we had presented the matter to our officers—we were allowed a little more freedom in renewing ties, because we showed very conclusively that taking out the ties a little sooner saved considerable in track-labor. I do not know whether the Committee considered that or not. I think it is well worth looking into. Do you catch the point, Mr. Kittredge?

Mr. Kittredge:—I do not.

Mr. Hutchinson:—We found our track-labor was running very high and about forty-five per cent of the whole was caused by cross-tie renewals, and we looked into the matter, and we got a little better quality of ties. We renewed a little more extensively the following year, and we found in the third and fourth year, as a consequence, that our track labor was reduced, because we had a better quality of material in the track, and by making renewals a little sooner we found that it reduced track-labor. I do not know if that was what you had in mind.

Mr. Kittredge:—It was expected to get the cost of the various kinds of ties themselves. The cost of putting them in the track would vary in the different localities. I appreciate your remarks about the better qualities of the ties, but I fail to appreciate the force of renewing the ties earlier than you had been doing. I would understand from that that you would not get the full value of the tie in the track. I know some pieces of road where the theory is never to take the tie out unless you take it out with a shovel. I do not think it is wise to go to that extent, but I do believe in getting the full value of the tie before renewing it.

Mr. Hutchinson:—In that batch we included surfacing of our track with old ties, and with them, of course, the track was

bad. It takes more labor to keep the track up. I did not, perhaps, make that clear, but that was included. When we get good ties in, we do not have to spend as much money on maintenance.

Mr. E. E. R. Tratman, Resident Editor "Engineering News";—I only want to make a suggestion. I made a statement similar to this table some time ago in the discussion of preservation of ties before the American Society of Engineers, and I included the tie-plates. That makes a very great difference in the life of your ties, whether the ties, all of them, or only a certain proportion (as at joints or on every other tie), have steel tie-plates. I think that should be included in the tables.

Mr. Kittredge:—The cost of the ties and percentage of ties plated is referred to in column 16, and in the note below the cost of the tie includes the tie itself, tie-plates, and spike plugs.

Mr. Tratman:—There is another point: That is, the difficulty of finding what is the life of the ties after they are once put in. It is hard to know when they are put in. Very few records are kept, unless the ties are of special importance. I think Mr. Kittredge tried marking them with hammers. I do not know whether those marks remained long enough, but it seems to me some system of marking with tacks or tags should be used if you are going to keep any accurate records.

Mr. Kittredge:—In regard to the marking of ties, that was started on one of our divisions in 1892 or 1893. We had a steel hammer made with the letters or figures "92" on it, and that was driven into the end of the tie and into the top of the tie on the line side. We did not find that it worked very well, because at the end of a few years a great many of the marks were effaced and the practice was discontinued, having been kept up only about three years. We found that so large a per cent of the marks had gone—whether we did not mark them sufficiently in the first place, or whether any marks we had put on in that way would have been eroded or not, I cannot say—but the practice was discontinued after a few years on account of its not furnishing us the information that we thought it would give us.

Mr. Samuel Rockwell, Principal Assistant Engineer Lake Shore & Michigan Southern:—On our road we have been marking ties since 1893. I have been using a cast-iron hammer and a very large figure three, four, five or six—of course, you can

guess at the ten—and the "three" marks are still discernible, although they are dim; but we mark all our ties, and think it pays.

Mr. W. G. Curtis, Engineer Maintenance-of-Way Southern Pacific:—I am familiar with the method of keeping account of ties in the form of this blank. It adds only a very little to a blank that we have been using a great many years, and I would like to add a little emphasis to the proposition that it is not much work. When you have once made up the proper form of report that leads up from the section foreman and then to the main office, the amount of work involved is very little. It may look like a big job to start it, but it is not difficult to keep it up.

We have practically all of the statistics of our line that are required by that blank. We have had them for about ten or twelve years. As to marking, our method is the same as indicated by the last speaker. We make a cast-iron hammer—quite a large one; the figures are raised on it about one-eighth inch, perhaps a little more, and we have been using those since 1892 or 1893. There seems to be no very great difficulty in reading them. In some sections, where they are very much exposed, they may sometimes be obliterated, or may be a little dim, but for practical service we find they answer the purpose. We use that for pine ties, redwood ties and cedar ties. That hammer is turned into the scrap pile every year and another one made.

I think it important that the life of ties should be determined in some such way. I think the better way may be to use a galvanized tack, such as our friend here, Mr. Chanute, has devised, with date on the head. The imprint with the hammer looks very feasible, and is not very expensive, but in places where the nature of ties and climatic conditions would make the hammer marks illegible, certainly a numbered nailhead is not very expensive and not very difficult to apply.

Mr. A. Torrey, Chief Engineer Michigan Central:—The marks of 1893 were put on ties on the Michigan Central, and the ties are still in and show those marks.

Mr. Curtis:—We keep no special account of the life of ties, except the treated ties. We have established in our practice to our satisfaction the average life of ties of ordinary timber—the redwood tie, for example. We know about how long it will last, and, of course, we have, through long years of renewal, the

average number we put in in a year. That fixes the broad average of the lifetime for them, but we keep a special account of the life of all the treated ties, and probably shall do so until we establish it. The life of untreated timber, as we all know, varies a great deal, according to the soil, according to roadbed, and the climatic conditions. To illustrate: In Nevada, or in Utah, in the bottoms of the old lake beds, where the soil is pretty well filled with salt and potash, there are ties still in good condition, not a particle decayed; they were laid when the road was built in 1868, but in that same country there are stretches of light, sandy loam roadbeds, where the same kind of tie will go to pieces in three or four years—sometimes, in some places, in less than that; but, as I say, during long years of operation we have made up our minds pretty well about the ordinary, untreated tie and the redwood tie, and we are only concerned now in knowing what will be accomplished by the treatment of ties, which we began about twelve years ago on our Atlantic properties, and about eight years ago on our Pacific properties—the latter aggregating about 5,500 miles.

Mr. Torrey:—I would like to ask whether those ties are marked at the time of inspection or at the time of putting in the track.

Mr. Curtis:—At the time of putting in the track. It is part of the duty of the section foreman—a rule which the roadmaster is required to enforce—that when the new ties have been laid in track, men walk along with a sledge and strike the date of putting in the tie.

We do not consider that a tie deteriorates much meanwhile, and, for that matter, there is only a short interval between treatment and use of the tie. We do not carry them much ahead in stock. I do not know that we carry them quite long enough, but it so happens that we generally want a tie in the track as soon as it is treated and ready to go in. We treat, I might say, all the pine and spruce ties.

We have a large, portable treating plant, which will treat about three thousand ties a day, which we set up at the various places, and the effort always is to interpose it between the place where the ties are delivered and the point of use, so that there will be no extra hauling of the ties on account of the treating process.

I might say that the California tie situation is not just now very satisfactory. We bought about a quarter of a million ties way down in Texas, and this portable plant we shall move from its present location about twelve hundred to fifteen hundred miles, down to a point near El Paso, and treat these ties on their way from the point of delivery to the track. We consider the portable plant one of the most useful plants that we have in connection with the handling and treating of ties.

The President:—I would like to make a few remarks personally on this tie question. There is no one item of railway maintenance that there is as much money involved to the roads as there is in the tie question. On the road I am connected with—the Illinois Central—we use for our maintenance, renewals, and for our new sidetrack construction-work on an average about two million ties a year, costing us between $600,000 and $700,000 for ties alone, delivered alongside the track. The work of this Committee is a very important one, and it seems to me that their first step should be to gather information in the form of blanks, which they can circulate at the expense of this Association under our arrangement for that work, so as to get from all the roads definite information as to what they are doing, in order that we can all make our reports on the same basis.

As it is now, I presume there are no two railroads in the United States who handle that question along the same lines. It has been our custom to make our tie inspection in the autumn, and require our supervisors, who have charge of about one hundred miles, to personally walk the track with their section foremen and take a memorandum of the number of ties for each individual mile that, in their judgment, needs renewal. These reports are made to the Roadmaster, who has charge of from three to four and five hundred miles of track. From the Roadmaster the report goes to the Superintendent, from the Superintendent to the Assistant General Superintendent, and thence to the Chief Engineer. From the Chief Engineer these reports go in to the management in making up the annual budget. The reports go as far as the Chief Engineer, indicating the exact number of ties for each individual mile. For instance, each division reports what it needs as a whole, and each supervisor's section, to the Chief Engineer; any intermediate officer can turn to that report and can see how much is wanted on the

work under his charge. It is our custom to have the Roadmasters and Superintendents go over their division and take this report and pick out individual miles and walk the track themselves in order to gauge the judgment of their respective supervisors.

During the time that I was Chief Engineer—and I presume our present Chief Engineer follows the same course—I used to go over that inspection and those reports and take the Assistant General Superintendent and Division Superintendent, and we would pick out special miles where new ties were recommended. We would walk the track and count those ties ourselves in order to check up the judgment of the division officers and of the supervisors. When the final demand for ties was made, these reports were taken into consideration, and the normal amount of ties needed for the renewals based upon our record of ten years past, the number of ties taken out of the track, and our general judgment as to the necessity for those renewals. After this system had been in use several years we were able to educate our supervisors, our section foremen, and our division officers also to such an extent that for over five years I do not think we varied any in the allotment of ties that came in from the division officers' recommendations.

In the spring, after the ties were allotted, distributed, and put in the track, the bad ties were piled up and those piles were frequently inspected by the officers, in order to see the nature of the ties that had been taken out of the track before they were destroyed or used for other purposes. You cannot surround the tie question and the treatment of ties with too much actual care and supervision. You may, on some divisions, have ties taken out of the track that could last economically one or two years longer, or three years longer, and you may, on other divisions, be too saving, and it is a question that requires the greatest care and consideration to properly and economically handle. It is very important for us to know not only the normal life of different characters of wood and different characters of ballast and in different climates, but to be able to determine about what the normal renewals will be, so that if our division officers on a certain division are recommending each year more ties than the character of the climate, the character of the ballast and character of material would seem to warrant from the records which we

get from the country, those particular men can be looked up and more closely watched, to see whether they are getting things correct or not. It is only by close methods of this kind that we can economically handle the tie question.

Mr. Curtis:—You have stated exactly our general specifications for the care and use of ties. Personally, I regard the looking over of the old tie piles as perhaps the most important point of all. All ties, as they are taken out of the track, should be held until inspected by the proper officer. Sometimes ties will be taken out and properly used in sidetracks. They should be piled in one way. The ties entirely useless, which are to be burned on the ground, should be piled in another way, and the new ties still in another way. You will then have a quick check on the judgment of foremen and division officers. If you can find any serviceable ties piled in the manner specified for useless ties, you have the text for the sermon to be delivered with any emphasis you think necessary; but so long as a responsible officer sees all ties in the useless pile before they are destroyed, we can be pretty certain that no ties will be improperly used.

The President:—I think it will be a great deal of interest for us to hear in a few words from Mr. Chanute the present situation in regard to the treatment of ties.

Mr. O. Chanute, Consulting Engineer, Chicago:—I will say that abroad all ties are treated. This obtains almost through the whole of Europe, and no ties are laid down except after they have been treated. In this country, out of about 100,000,000 of ties which are renewed annually, something like one per cent has hitherto been treated. This year it is probable that about two and one-half or three per cent will be treated with various preservatives, but I entirely agree with what the Chairman has said as to the probability of our soon arriving at a tie famine, and I feel very confident that the best economy will lie for our roads in adopting for themselves various methods of chemical treatment. It was for the purpose of obtaining information as to what had been done abroad for the last sixty years that I went there last fall and gathered a large volume of information which will be very much at the service of the Committee.

The President:—Is there any gentleman present who is at all conversant with the record of metallic ties? Did you look into that, Mr. Chanute, when you were abroad?

Mr. Chanute:—The metallic ties are looked upon with but little favor at present. A great many miles have been laid with metallic ties, but it has been found that mistakes were made—that they were not made heavy enough, that they rusted, and when an accident occurred they were distorted and could not be used again, so that there has been a reaction against the metal tie abroad. All the roads in Germany, in France, and in England are laying down wooden ties creosoted, or treated by other methods, but chiefly creosoted.

The President:—Are their records full enough to give an idea from actual service of the increased length of life through treatment?

Mr. Chanute:—It depends very much on the thoroughness of the treatment. The English creosote their ties at the cost of about twenty-five or thirty cents, and they get fifteen or sixteen years of life.

The President:—That is additional?

Mr. Chanute:—No; life in the track. The French do the best work by injecting sixty pounds of creosote at a cost of sixty-five cents a tie, which is simply prohibitory to us here, but they get a life of from twenty-five to thirty years with the most perishable woods there. Beech ties last an average of twenty-seven years in the track under the heaviest traffic, and then, in the periodical relaying, the best ties are taken up and relaid in the sidetracks, where they last seven or eight years more. In Germany they obtain fifteen to eighteen years' life from ties, which are chiefly of beech and the pine, but the life depends very greatly upon how thoroughly well the work is done, the precautions that are taken, the inspection at the various points, and especially upon the care which is taken as to the drainage of the ballast and the mode of fastening. I would say for the information of members that the spike is practically abandoned abroad. It has been replaced with a lag screw. There are still spikes used in a small way, but they may be said to have disappeared as track fasteners. The advantage of the lag screw is that it holds the rails firmly to the tie, prevents cutting, prevents that flapping which is so injurious, and especially prevents the collection of moisture into the spike holes to begin the process of decay. I hope that the members will experiment with lag screws as a means of fastening. I am thoroughly satisfied that the spike is

a relic of barbarism, and that it will probably disappear in this country within a few years.

Mr. Torrey:—We appreciate very much what Mr. Chanute has said. A good many members, perhaps, of the Western roads especially, and I myself, have been interested in forestry, and would be glad to get some information in regard to this matter as applying to countries where the wood is scattering or where there is no wood at all. I would like especially to hear in regard to the culture of the catalpa tree.

Mr. Chanute:—In regard to forestry, most of the European nations have taken the matter in hand. Many of the forests belong to the State, and they are cared for and regulated by the State, and even the private owners are hampered by regulations, so that they may not cut down the forests unduly. In England, practically all the tie-forests are gone, and England is importing all of its ties; therefore, it is not necessary to apply any regulations there as to the cutting down of the woods. In Germany and France the State owns large bodies—about twenty per cent, perhaps, of the forest area—and regulates this by careful inspection; plants trees and new forests; regulates their cutting down and thins out the woods when they require it, and regulates the cutting of forests belonging to private individuals.

In the specifications for furnishing ties the contractor is required to state from what district—in what district—the ties are to be cut, and the agents of the State supervise the cutting, so as to make sure that the cutting shall be done to the best advantage and with the least possible destruction of the forest growth.

We have had in this country for the past twenty years a forestry department which has been preaching the proximate destruction of the forest. We have paid little or no attention to it, and we have at length arrived at a point where it will be a matter of very great concern to us to adopt some similar measures—less fraternal, probably, than those which are used abroad.

The President:—Are there any others that can give us any light on this question, or have any of the members any further remarks to make on the tie question?

Mr. Tratman:—I was just about to state in regard to metallic ties that I had a communication from Germany a few weeks ago, in which it was stated that about one-third of the ties ordered

for the government railways of Prussia for renewals during the present year were to be of steel. I also had a report from Switzerland, in which they report continued favorable results; they are now using heavier ties, and the Gothard Railway uses steel exclusively, excepting in the tunnels. They are very largely used in India, where they have a hot, dry climate, and in South America and Mexico they are also used extensively—both in the wet and in the dry sections.

The President:—There is one question in regard to metallic ties, and that is their behavior where they are used on railways that have electric circuits or systems, and where the tracks form circuits. I suppose it may be possible to overcome any interference by proper insulation, but it will be a problem in the question of using the metallic ties.

Mr. Kittredge:—On the subject of forestry I want to state the very limited experience which the road with which I am connected—the Big Four—has had in regard to setting out trees. The State of Indiana has recently passed laws in regard to the establishment and maintenance of forests. If a certain number of trees per acre can be maintained over any specified and described portion of land for a period of three years, that land can be entered for purposes of taxation as forest land, and taxes can be paid on a valuation of one dollar per acre.

Our company has, in a number of places, abandoned gravel pits and pieces of outlying property, which are not in daily use in connection with the operation of the road, from which they derive no benefit except the benefit of taxation. Last fall one particular piece of land, containing about thirty acres, was plowed and cleared and set out during the fall with some thirty thousand catalpa trees, and we expect during the present month to set out about twenty thousand additional; the land last year was not in condition for the additional number, on account of growing crops, to be available for that purpose, but we will treat it this summer. These trees were contracted for at the price of one cent per tree—that is, the fifty thousand trees were set out—or they will all be set out this spring—they were to be set out and taken care of for two years for the round sum of five hundred dollars. It seemed to me that that was an offer which our company could not afford to let go by, and I succeeded without any difficulty in getting the appropriation for it.

We are, of course, very much interested in it, but it is entirely too early yet to say with what success we shall meet. A report recently made on the condition of the trees set out last fall indicated that quite a number of them—perhaps one or two per cent—had been thrown out of the ground by the winter's freeze, but apparently were not damaged, and the remainder were not disturbed.

We have one or two other small tracts of land that we have set out with catalpa and other quickly-growing trees for the purpose of seeing how they will develop in the way of furnishing timber partly and partly to reduce our taxation.

Within the city limits of Indianapolis we have an old abandoned gravel bed of some five or six acres, that we set out with trees a year ago—mostly catalpa—and entered that with the State officials as a forest. At the end of three years we will make quite a saving in our taxes on that particular piece of ground. These taxes have been quite heavy and we will make a saving, even if we don't get any results from the timber.

The trees set out on that ground over a year ago average in growth about two feet, I think, during the past year, and I suppose that ninety per cent of those that were set out are still alive and growing. The report is, of course, a very meager one, and is given to show that a beginning has been made.

Mr. D. Bontecou, Chief Engineer Kansas City, Fort Scott & Memphis:—I would like to ask Mr. Kittredge what specially led to the choice of the catalpa tree.

Mr. Kittredge:—The principal consideration was its rapid growth, and its value as a tie-timber and as fence-post timber, and as timber to be used in connection with other railroad work, especially where it comes in contact with the ground. It is one of the most lasting timbers that we have in our immediate vicinity, and it grows very rapidly. It is estimated that within eight years we will have trees large enough to make fence-posts, and that within sixteen years we can begin to cut timber for ties.

Mr. Bontecou:—I am interested in asking that question, because the Fort Scott & Memphis road planted, some years ago, two square miles with catalpa timber, and I think there is hope that some time this year they may cut some fence-posts, but they have never got any ties out of them, and I think that covers an experience of twenty years.

Mr. R. C. Barnard, Engineer Maintenance-of-Way Pennsylvania Lines West:—For Mr. Kittredge's information I would say that about fifteen years ago we set out on our road about twenty-five thousand of these catalpa trees with the idea that they would in a short time make good ties or fence-posts.

To-day I should think that eight inches would be a fair average diameter for these trees. They were unfortunately set on both sides of the track, and it takes a man about three months each year to keep them trimmed so that they will not interfere with the telegraph wires. They are of rapid growth of branch, the young shoots growing from ten to fifteen feet in a season, but the size of the trunk does not increase very rapidly. Our experience with them has been disappointing.

Mr. Curtis:—It occurs to me that it requires some study to hit upon the tree that is best suited to the different climates. We in California planted catalpa trees some twenty years ago; at the time there was much said about them in the press—about the time there was the first agitation about it. We scattered these trees broadly over the State, and now they are twenty years old and they don't average over four inches in diameter in the best places, and in other places they have not grown at all, except in the shape of a shrub. They have not actually grown into a tree. The places where they have grown best is in the moister parts of the State, and the places where they are not thriving is in the drier parts, and my impression is that there is no general rule that can be applied. In California it is our experience that they require the moist soil, and certainly they will not grow in the dry places and through the dry, hot summers.

The President:—Our time is so short we will have to close this discussion at this time, although it is a very interesting one, and the Committee have treated the matter very thoroughly and the discussion has brought out some very important points.

I will next call on the Committee on Ballast. I now have the pleasure of introducing Mr. Peddle, the vice-chairman of the Committee.

Mr. W. H. Peddle, General Superintendent of Maintenance Southern Railway, here read the report of the Committee, as follows:

REPORT OF COMMITTEE II.—ON BALLASTING.

To the American Railway Engineering and Maintenance-of-Way Association:

Pursuant to the circular issued by our President and Secretary, under date of February 12, this short paper has been prepared in the endeavor to outline the scope of this Committee's work, and suggest the manner in which it may be carried on. The intention of the speaker is simply to bring the subject-matter before the convention in the hope of provoking general discussion by the members at large now assembled here, so that your Committee may have the benefit of this discussion when it meets to take up its work.

Ballast may be defined as the material above the roadbed in which the cross-ties are imbedded, and its object is to get a solid and uniform bearing for the cross-ties, to distribute the applied load over a large surface of the roadbed, to hold the cross-ties firmly in position, to give elasticity to the track and to allow water to pass off freely, thus avoiding churning in wet weather and heaving by frost. The importance of ballast for the proper maintenance of track is pretty generally conceded and understood.

The five subdivisions of ballasting, as outlined by your Board of Direction in the programme are as follows:

1. Material:
   - (*a*) Stone—size, quality;
   - (*b*) Gravel—cementing, loose, sandy;
   - (*c*) Burnt clay—quality, method of burning;
   - (*d*) Slag, cinder, and burnt shale;
   - (*e*) Chatts—character;
   - (*f*) Earth;
   - (*g*) Dust prevention.
2. Standard cross-sections (variations, modified by material and other conditions).
3. Cost:
   - (*a*) Material alone;
   - (*b*) Loading;
   - (*c*) Transportation;
   - (*d*) Unloading;
   - (*e*) Placing under track;
   - (*f*) Surfacing and dressing.
4. Methods:
   - (*a*) Handling material;
   - (*b*) Keeping trace of cost and accounts.
5. What constitutes ballasted track?

The arrangement of these subdivisions is admirable, and the scope covered by them well-nigh complete. It is desirable, in discussing the subjects covered, that they be taken up in their regular order, and that

members call attention to any subjects pertaining to ballast that do not appear to them to be contained in the list.

If no better method is suggested, it is the intention of the chairman of this Committee to assign a particular subdivision of the committee-work, as outlined in the programme, to each of the five committeemen, who, with the chairman and vice-chairman, compose the Committee. Each of these committeemen, with the assistance of our Secretary, will collect statistics and tabulate them to accompany their reports to the chairman, who will submit these reports to the other members of the Committee for their suggestions and criticisms, after which the Committee, from time to time, will meet for discussion and to prepare its reports.

In an effort to slightly elaborate the list of subdivisions, as contained in the programme, the object will be more to acquire knowledge than to impart it.

SUBDIVISION 1: MATERIAL.—(*a*) Stone—size, quality. There exists a wide diversity in practice with regard to the size of broken rock ballast, although the tendency appears to be now in the direction of the smaller sizes.

The question to be decided is, What sizes are the best, taking into consideration the various locations and conditions under which the ballast may be used?

The quality of stone should be such as to resist disintegration under tamping or from the effects of the weather. What are the other requirements as to quality?

(*b*) Gravel—cementing, loose, sandy. Gravel is, perhaps, the material more largely used for ballast than any other, occurring, as it does, in large deposits, widely distributed, as gravel pits deposited by water in the past, as well as in river and creek bottoms of the present. It is usually readily accessible, cheaply loaded, and with it track can be economically maintained. In considering the economic maintenance of track, the character of the gravel will have to be taken into account—whether it is cheaper to maintain track on cementing gravel, or on loose, or on sandy gravel. Here, as in many other cases, it will be necessary to encroach upon the subjects allotted to other committees: What is the cost of renewing ties in the different kinds of gravel, as also in the other materials used for ballast? What is the life of ties in the different kinds of ballast? What is the effect of the sand on wear of rails? We might even carry the inquiry outside of the department interested in the maintenance-of-way, and ask what effect has the sand on the tires of rolling-stock? This may seem, at first sight, a little far-fetched, yet the records of the Louisville & Nashville Railroad for the Mobile and Montgomery division now show an average of 16,000 miles run to 1-16-inch wear of engine tires, whereas formerly 9,000 miles was the average, and the superintendent of machinery attributes the difference to be due to slag ballast having been substituted for sandy gravel ballast. If the tires of an engine are so greatly affected by the use of sandy ballast, what is the effect on other parts of the rolling stock?

(*c*) Burnt Clay—quality, method of burning, etc. Having had no personal experience with this material, it will be passed, with the hope that members who have had such experience will enlighten us. It would seem that where a good natural ballast is readily accessible, an artificial article would not be advisable, and that the distance from nearest coal-field would enter largely into its cost.

(*d*) Slag, cinder, and burnt shale. The use of slag as ballast is growing in favor. In the South, the "hot-pot" slag from the iron furnaces is of particularly good quality for this purpose. The slag is poured from hot pots, run on trucks to the dumping point. It spreads itself in thin layers, which renders it hard and brittle, easily broken to suitable size for ballast. The slag formerly made at these furnaces was of a porous character, hard to break to the proper size, and with a tendency to cement together again, hence it made poor ballast.

Cinder—Cinder is a waste product on all railroads that run coal-burning engines. It is used by most of them as ballast; if not on their main lines, then in yards and for sidetracks. Where the roadbed is soft, excellent results have been obtained from its use.

It is claimed by some that cinder ballast is destructive to both the ties and rail. The experience of the members present in this particular, as well as all others, would be instructive.

Burnt Shale—The speaker has no personal knowledge of this material, so that any remarks with regard to it will be information to him.

(*e*) Chatts—character. Chatts are the tailings from lead mills, and are about the size of very coarse sand. The lead ore is separated from the quartz rock after being crushed.

Chatts are regarded by some of those who have used them as the ideal ballast, easy to tamp, making the renewal of ties cheap; heavy in weight, hence holding the tie in place, and comparatively free from dust. Those who have had larger experience with this material can doubtless tell us a great deal more about it. I have here a sample of chatts which may be of interest to members who are not acquainted with it.

(*f*) Earth—Earth as ballast has been largely used in this country in the past, and few large railroads can be found at the present time that have not some part of their lines ballasted with earth or "dirt," as it is often called, when it is not designated as "no ballast." If it has happily disappeared from the main lines, it is yet to be found on the branches, where light business will not justify more expensive ballast. An interesting question is, How should track ballasted with earth be maintained? In some parts of this country it is customary to crown the earth above the tie in center of track; in other parts of the country it is customary to make the top of the clay ballast level with the top of the tie.

Other materials that have been used for ballast might be mentioned, such as rock screenings, for top surface of yards between the tracks, where they present a clean and neat appearance and render the movements of trainmen easy and safe.

Chert—Chert is also used to ballast branch lines in the South, and is

infinitely better than ordinary dirt, though not the equal of rock, slag or the best character of gravel. It is excellent at road crossings. A sample of chert is also here for the benefit of those unfamiliar with it.

Doubtless some of the members present can add to the list of materials suitable for ballast.

(*g*) Dust Prevention—Until recently, no serious attempt was made to prevent dust rising from the ballast of track, except by permitting grass to grow over the track; for example, Bermuda grass in the South. Within the past few years oil has been used for this purpose, apparently with success. It is claimed to not only lay the dust, but also to prevent growth of weeds. The Eastern roads were the first to adopt it, and it is to be hoped that some representative of that section of the country can enlighten us as to its merits.

SUBDIVISION 2—STANDARD CROSS-SECTIONS (Variations modified by material and other conditions).

To present this subdivision properly it will be necessary to obtain diagrams of the standard cross-sections for ballast of the principal railroads for comparison. Nearly all railroads have adopted such standards, yet they are not, and cannot, be strictly adhered to in all cases. The character of the material of which the subgrade is composed, as well as other conditions, necessitate modifications. The section on curves is, of course, different from the sections on tangents.

SUBDIVISION 3—COST.—To discuss this intelligently necessitates statistics, which are not now at hand, but which it is hoped to secure later.

SUBDIVISION 4—METHODS.—(*a*) Handling Material.—This should include a description of the methods adopted in expending the money covered by the loading, transporting, unloading, placing under track, surfacing and dressing. To attempt to describe the various modes of conducting these operations is not within the scope of this short paper, further than to say that gravity is used as far as practicable, supplemented by steam power, as at the crusher with its screens, at the steam shovel in loading, in transporting, in unloading from dump cars, or by means of plow, and in spreading the ballast. Due care should be exercised to avoid the loss of material in conducting these operations, particularly the last two, else much of the ballast is liable to go down the bank. The placing under the track is accomplished by means of jacks, shovels or ballast forks, and tamping-bars or picks, in addition to which levels and lining bars are needed in surfacing and lining. It is desirable to learn the proportionate force usually employed at these different classes of work, which are all conducted at the same time.

(*b*) Keeping trace of cost and accounts. This is by no means the easiest thing in connection with ballast; that is, if the accounts are to be accurate. In ballasting an unballasted railroad it can be done, but in reballasting a railroad which has already been ballasted, or partially ballasted, where the work of overhauling, re-tieing and possibly re-spacing of ties is being conducted at the same time, it is not so simple. The section foreman who distributes the expense of labor is seldom an expert accountant.

SUBDIVISION 5—WHAT CONSTITUTES BALLASTED TRACK?—No attempt will be made by the speaker to elaborate this subdivision, which will be left for the Committee in its future reports.

Full ballasted track does not mean the same on all lines. It is largely dependent upon climatic conditions, character of material composing the roadbed, weight of rolling-stock, the daily number of trains and their character—whether passenger or freight; nor is it permanent, for it requires repeated renewals from time to time.

R. MONTFORT, Chief Engineer Louisville & Nashville, Louisville, Ky., Chairman;
W. H. PEDDLE, General Superintendent Maintenance Southern Railway, Washington, D. C., Vice-Chairman;
A. MORDECAI, Assistant Chief Engineer Erie Railroad, Cleveland, Ohio;
J. R. LEIGHTY, Roadmaster Chicago & North-Western, Carroll, Iowa;
EDWARD SHELAH, General Roadmaster Wabash Railroad, Decatur, Ill.;
J. T. RICHARDS, Engineer Maintenance-of-Way Pennsylvania Railroad, Philadelphia, Pa.;
H, U. WALLACE, Division Superintendent Illinois Central Railroad, Freeport, Ill.;

Committee.

The President:—Gentlemen, this subject is now open to you.

Mr. W. McNab, Assistant Engineer Grand Trunk Railway:—In regard to dust prevention, mentioned in the report, of course there are certain qualities of ballast where grass, or even weeds, will not grow. And even in those qualities where, with a mixture of earth, it will grow, it is always unsightly, and on a first-class road—and, as far as that is concerned, on any road—it is not allowed, and therefore I think the suggestion thrown out in the report, that we should obtain the experience of those who have used oil, is a good one. We should know the description and quality of the oil, and the methods by which it is used—whether by a tank sprinkler attached to a train, or by an ordinary nozzle, used by the section men, as well as its cost; and, in speaking of cost, and the cost of ballasting, I know that there are so many conditions on which this depends and the difficulties in arriving at subdivided details are so great, that it has been no easy matter in the past to formulate figures for comparison. I think, however, that if every member of this Association and every engineer who has any work under him, whether in ballasting or in any other work that refers to the scope of this Association, would make a special experiment this year to determine the precise subdivided cost of the work upon which he is

engaged, with a view of giving the same to the Association, some understandable basis could be arrived at.

In the cost of ballasting, if the foreman of the pit, the train foreman, the foreman of the track and others interested would all understand what we are striving to ascertain, I think it would assist us, and I am sure we would be able to get some basis which we could use for the purposes of comparison. This suggestion that is thrown out with regard to cost of ballasting, I mean also to cover all classes of works which it may be necessary to refer to in future papers.

The President:—Mr. Hutchinson, can you give us some data in regard to the use of oil? I believe they used it on your line.

A Member:—Mr. Hutchinson is not present—he stepped out a moment ago.

The President:—I think the Pennsylvania used it on some of their lines—that is, some of their branch lines, where they have sandy ballast and the travel is heavy. I was over their branch line to Cape May last July, and they applied oil to that, and while there was no dust flying in the atmosphere, after I had made my trip I ran my hand over my face and found that there was sand and oil there together, so that the dust was not eliminated entirely, but the use of oil kept down the dust so as to allow you to see the track all right.

You can barely distinguish the odor, but it was not disagreeable. The process, I understand, was very expensive, not so much in regard to its practical application, on account of the cost of the material used, but on account of the royalties, and that is so high that it would be prohibitory on large roads—that is, roads that have a large mileage.

Mr. Hutchinson, we inquired of you while you were out. Can you give us some idea of the cost of the use of oil on the Pennsylvania?

Mr. S. P. Hutchinson, Assistant General Agent Pennsylvania Railroad:—I understood it was estimated to be about $50 per mile, but I don't want those figures to be taken as gospel, because personally I have never used any, and I cannot speak positively, therefore, but I think $50 a mile is about right. Mr. Shober here says he thinks it is $60 a mile.

The President:—Is that the material, the application, and the royalty?

Mr. Hutchinson:—I think all three.

Mr. S. L. Shober, Jr., Assistant Engineer Pennsylvania Railroad:—It was crude petroleum oil that was used, and it was applied from an ordinary oil-tank car with a swivel arm. Steam was introduced from the engine to make the oil move freely, and the arm was swung out over the adjoining track. I think it cost $60 a mile for single track, $120 for two tracks, for each application, and they made two applications a year and thought it satisfactory. They spent about $240 per mile per year on it. There were reports of the trouble you mentioned in reference to the accumulation of dust on clothes. I heard there were a few complaints from the passengers—that is, women—in reference to their clothes being spotted by these accumulations. It is being discontinued at the present time between Philadelphia and Atlantic City, however only on account of the desirability of putting that portion of the road in stone ballast.

The President:—It did not strike me as satisfactory. It struck me very forcibly that the cost of oil application, if it had to be kept up every year, would amount to more than what would take care of rock ballast, and cost much more than the interest thereon, and that, therefore, it would not be economy in the true sense of the word.*

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*Mr. J. H. Nichol, Assistant Engineer West Jersey and Seashore Railroad, under date of March 31st, addressed the following interesting letter to President Wallace, with reference to the application of oil to road-bed:

"I read with considerable interest the discussion on page 236, Railway Age, March 16, 1900. Noting your finding sand and oil on your face after a ride over our Cape May division in July, 1899, I would say that only small portions of that division have been oiled, the dustiest locations being selected; the sand came from the unoiled parts, and the oil on face can very fairly be attributed to the natural secretions in as warm a month as July.

"The cost of oil was, in 1898, two cents per gallon, or $40 per mile of single track; the average cost of freight and labor of applying, all charges, including engine service, $5 per mile; total, $45. There is a single payment of $20 per mile royalty which covers the whole life of the patents, so that subsequent oilings would cost about $45 per mile. At present, owing to trade conditions, oil is three and, in some localities, four cents per gallon; the freight and labor charge remains the same.

"The oil is a residuum of petroleum of 24° to 28° Beaumé, practically

In reference to the cost of the ballast work, that is a matter, it seems to me, that the Committee should very carefully analyze, so that when they are asked for information they could give data from all the roads, and give it on a uniform basis. Every person that I know of within my experience, in giving the cost, or in getting the cost of an element, gets it from different divisions of the road, and there is great inequality because

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non-evaporative. At any temperature over 50° Fahrenheit it is not necessary to use steam to expel oil from pipes; cost is given above. Any new device will, of course, meet with criticism, and I have heard expressions of opinion that if the dust raised contained oil it would soil clothes, etc. Although connected with the division of the Pennsylvania Railroad where most oiling has been done, and having watched the work closely from the start, I have not found one instance of damage to clothing caused by oil; the fact is, that dust light enough to be lifted by trains contains no oil, or so little that it will not give it off. The dust lifted on our lines is from unoiled portions, or in the oil from extensive disturbances by renewal of cross-ties, and not yet re-oiled. At the latter places, a rain following disturbance floats the oil to surface and practically renews it. We are not discontinuing its use; in fact, have spent an increasing amount of money for this purpose each year since 1897. The year 1899 was such a successful one as regards net receipts (attributable to the use of oil, and in fact dependent upon it, partly at least, as without oil our Atlantic City division would have been unbearably dusty), that we are now stone-ballasting the Atlantic City division, 58 miles of double track, 100-pound steel in 60-foot lengths, only needing stone ballast and automatic signals to make it standard, both of which are now being done. We shall continue to use oil on the Cape May and other branches, and on road crossings on the Atlantic City division.

" . . . We do not expect to continue its use indefinitely; in porous material, with disturbances incident to surfacing or renewal of cross-ties, three applications have penetrated to a depth of seven to eight inches, so that a rain following disturbance restores the oiled surface, as before stated.

"One of the most important results of the use of oil is not cited in the discussion, viz., *the waterproofing of the surface*; track labor is thereby saved; there is no freezing, and, consequently, no heaving by frost in the spring, and no loss of ballast by heavy rains. We have escaped washouts of gravel-ballasted tracks across salt marshes on the coast, submerged in Northeastern storm tides, since oil has been used on them.

"I refrain from adding to this already long letter a list of the secondary benefits, such as prevention of weeds, preservation of cross-ties, prevention of fires from hot coals dropped from engines, etc. I shall be glad to give any information you may desire, and shall be indebted if you will kindly refer this letter, or a copy of same, to the chairman of the committee, Mr. Montfort."

all of the elements are not taken into consideration, or the different people work it out in a different way. For instance, there should be taken into account the cost of the land on which the quarries, or the beds, may be situated, and the royalties you have to pay and the stripping of the beds or quarries, to get at the cost, and in rock ballast, the excavation of that rock, the crushing and the unloading and the loading of it on the cars—all of these should be considered; in the gravel ballast, the excavation of the ballast and the loading of it on the cars and the transportation of it, should be taken into consideration. In considering the ballast work, the special trains that are generally provided for that purpose should be considered, switch engines may be necessary at the ballast pits or at the quarries, and then there is the matter of repair ballast—a great deal of repair ballast may be done, particularly on second-class or intermediate lines, through the handling of the ballast on local freight trains, dropping off a few cars in a place, or dropping the ballast out of the Rodger ballast car and letting the section force work it in.

The next item would be the preparation of the tracks for the ballast—that is, how much work your ballast gangs do in dressing the slopes, cutting the grass out of it, or evening up the bank. The next item is putting the gravel actually in the track, and a careful separation should be made of the tie renewals, which may be made at the same time, and your surfacing or other work—that is, replacing the ties—that is done at the same time.

Now, if an outline of the different elements of cost are carefully thought out by your Committee, and they get the information on the same basis from the different roads, the result of their work will be very valuable to us.

Mr. Hunter McDonald, Chief Engineer Nashville, Chattanooga & St. Louis:—The Committee has stated that ballast is not permanent, and that we know—it requires repeated renewals from time to time.

I think it would be in order for the Committee to report on the life of ballast under various conditions, and I would also think it would be in order for them to report on the method of treating ballast after it has worn out—I mean by that, when it becomes foul. It is the practice on some lines to take the ballast out and sift it and put it back, and on other lines they simply put other ballast on top of it.

Mr. W. C. Cushing, Engineer Maintenance-of-Way Pennsylvania Lines West:—Complete as is the list of ballast materials given by the Committee, there is one material that has been omitted, and that is screened gravel.

We have been cursed with sandy gravel; that is not only dirty, but it is difficult to keep up the track with it, under the present heavy power in use on the different lines.

We have, therefore, started experimentally to use screened gravel. It has not been in use sufficiently long to enable us to determine whether it will be a good ballast material or not. It is just about intermediate in cost between stone ballast and good gravel, so that if it is successful as a track ballast it certainly deserves considerable consideration.

Most of us have to use sand in one way or another, and a good many lines in the West have sandpits on their lines, both for commercial purposes and for their own use. The screening of the gravel can be handled on that account quite economically by using the sand for commercial business and using the gravel on the line.

I think, therefore, it is worthy of further investigation. We have given it a little for ourselves. We hope to continue the use of it in order to determine its value. We were a little apprehensive that possibly the large kernels of gravel might be too smooth to bind well, but so far it does not show that result.

Mr. Curtis:—What is the method of screening adopted by you?

Mr. Cushing:—There is a special screening plant for that purpose, which consists of an elevator and a revolving screen, which reaches over two cars. The men simply shovel the gravel into the elevator, which is in continuous operation, and it is discharged into the screen, which is also revolving continuously, and the gravel drops into one car, and the sand in the other car. The cost will not be over twenty or twenty-five cents a yard. You can use any suitable appliance for that purpose.

Mr. Samuel Rockwell, Principal Assistant Engineer Lake Shore & Michigan Southern:—I would like to ask Mr. Cushing what proportion of sand he gets from the bank; that is, what proportion of the gravel is sand and what proportion is gravel.

Mr. Cushing:—That depends entirely on the location of the bank. The one that we are working in has about thirty per

cent gravel and about seventy per cent sand. If you could get a richer gravel deposit, you could get a larger percentage of gravel, but it depends entirely on the place where the gravel is obtained. We are unfortunate in having a very large percentage of sand on the division with which I am connected, and the screened gravel is intended to be intermediate between the poor sandy gravel that we have at present, and broken stone ballast, with which we expect our lines to be equipped in the future.

The President:—You all know that the Lake Shore has a very smooth track, and I think we would be interested to hear from Mr. Rockwell as to what effect the quality and kind of ballast they use has on that road—that is, what is the percentage of the total effect?

Mr. Rockwell:—Of course, ballast is absolutely necessary for good track; but smooth track is all a matter of standard. It depends upon the work you put on it and the way you do it. The reason why I asked Mr. Cushing as to the percentage of sand is that I have devoted considerable time to determining how much sand there is in our gravel—we have perhaps a dozen different pits scattered over the line—and we have determined that the sand in the gravel from them is just about one-half on an average—about half is sand and half is gravel, varying from the size of a grain of wheat up to an egg. I have been trying to interest our people in the screening of gravel and I am very much interested in what Mr. Cushing has said on the subject. In fact, I have already gotten up a sketch of a machine very similar to what he describes, but the question has been what to do with the sand.

Mr. C. A. Wilson, Chief Engineer Cincinnati, Hamilton & Dayton:—I would like to ask Mr. Rockwell whether the quality of gravel is not the first consideration with them rather than the cost. It has been my experience that sometimes the most expensive gravel is the cheapest, even if it has to be hauled a long distance. I would like to ask whether some of the reasons why the Lake Shore track is so good is not because their first attention is given to getting the very best quality of gravel obtainable irrespective of the location.

Mr. Rockwell:—We have several beds scattered over the line that have cementing gravel, which we have carefully avoided. We use altogether, wherever we can, gravel which does not ce-

ment. Our best beds are those from which the gravel is always loose.

Mr. Cushing:—I would like to say further that I have had some unfortunate experience with cementing gravel also, and I would avoid cementing gravel just as I would the plague, as Mr. Rockwell has done. We know that thirty per cent gravel and seventy per cent sand is bad, because we are troubled after every heavy rainstorm with the going down of the surface of our track, and that is what drove us to the consideration of screened gravel. At the present time some of our divisions are blessed with very excellent gravel in that respect, but the division with which I personally have to deal has no such deposits and I have to find something better.

We are pushing the renewal of the ballast on our road with broken stone, and that will be the ultimate ballast, but it takes a long time to ballast a road fully with broken stone, as a very large quantity is required.

So far as the handling of gravel ballast is concerned, it makes very little difference on a division where the bed is located. So far as the cost is concerned, it is the quality of the gravel that one is after and not the cost, but we can handle gravel from any part of our division for about four or five cents, or maybe, five and one-half cents per yard, with modern appliances, because when we take out gravel ballast we make a regular business of it just as we would with any other business, and the best equipment on the road and the best attention and the best of everything is given to that particular work, and we can handle it in the very quickest possible time, and in the past several years we have never exceeded in such cases six or six and one-half cents a yard, and we have handled it as low as five cents.

Mr. Peddle:—That includes the cost of distributing it?

Mr. Cushing:—That includes the cost of distributing it from flat cars—that is, the ballast unloaded. The reason probably that it has been so cheap is because we had a pit in an excellent situation in regard to the height of face of the bank, so that we were enabled to handle the gravel very quickly, and by having ample equipment of cars for that purpose we were not delayed in that respect. We were not hampered with a fewness of cars. If one is so hampered, of course the cost runs up. It takes about 250 flat cars to run a business of that kind, and haul it 75 miles.

Mr. Curtis:—What is the cost of that as compared with broken stone?

Mr. Cushing:—We are using about two-inch broken stone ballast at the present time, but if I had it at my disposal, I would use trap rock ballast, or something that is materially harder than limestone ballast, and would take it in size from an inch to an inch and a half. I don't think the coarse ballast is good. It makes it harder to adjust the surface of the track, and I would prefer the smaller size.

Mr. Hutchinson:—I would like to say that we are making tests of ballast on the Pennsylvania Railroad that is three-quarters of an inch in size. The dust has been carefully screened out of it, which, of course, increases the cost some. It is a little early yet to say whether it is a success or not. It has been tried on double track. I know of one point where it has been tried on a four-track section of the road on the outside track. I think the longest point at which it has been in use was a double track, where it has been in use five years under rather light traffic. We find that it takes a little less labor to surface the track, and the track is not near so noisy as when coarser ballast has been used. The tamping of the ties with three-quarter-inch stone takes less labor and it does not wear out the tie as fast.

There is the question of price to consider, and, as I say, it has not been in use long enough to allow us to determine it.

Another point—it has not been used at any place long enough to allow a very general renewal of the cross-ties to take place. The question of loss on renewal of the cross-ties will have to be considered, and, by-the-way, it is, what we call bastard limestone, which is harder than limestone for burning.

Mr. Peddle:—What does that cost on the cars?

Mr. Hutchinson:—It costs on an average of about fifty cents—the three-quarter-inch size costs sixty cents per cubic yard on the cars.

Mr. G. B. Woodworth, Rail Inspector Chicago, Milwaukee & St. Paul:—The Committee reports that they have no information about burnt ballast and burnt shale. I would say that our road burned some four or five hundred thousand yards of gumbo, as it is called—burned clay—and they also used burned shale or mine cinders, and both of them have given excellent satisfaction. The quality of the clay depends largely upon the char-

acter of the clay to be treated, the method of burning and the state of the weather. The cost of it, of course, largely depends on the cost of the slack and proximity to the mines.

The President:—What is the cost?

Mr. Woodworth:—The cost will vary. Some of it we get on our own lines and some we have to get from connecting lines, so that the price varies greatly. This is on a line that has no gravel pit, which puts the question of use of gravel out of consideration. The cost of the mine cinders was very low. It was simply the loading of them at the mine.

The President:—Do you not have a great deal of trouble with the dust in the use of clay ballast?

Mr. Woodworth:—It is very dusty when it is first put on the track. There is an ash that forms in the burning, and when first put on the track it is very dusty, but the first or second rain seems to soak it into the gravel, so that afterward it is very clean. It is clean as soon as a few rains have washed off this ash. It is then as clean as stone ballast, and we don't notice any dust arising from the tamping or the renewing of ties, unless it is when there are a great many to be renewed in one spot, which disturbs the ballast to a certain extent. But this is soon remedied by moisture or a rainfall.

Mr. Bontecou:—How long an experience has the Milwaukee road had with that ballast?

Mr. Woodworth:—The first clay ballast was put on the track about 1887 or 1888, and there is some of that that has had to be renewed where it was not put on to a sufficient depth, but where it was put on to a sufficient depth it seems to do very well.

Of course, it has gradually mixed with the soil, as eventually all ballast will, but it was very free from imperfections for a number of years, until it gradually gets a little foul.

Mr. Bontecou:—I am a little interested in that question of burnt clay, because it has always seemed to me that in speaking of burnt clay ballast there ought to be a clear discrimination made as to the hardness and thoroughness of burning. The Memphis road, about seven years ago, indulged in about twenty miles of burnt-clay ballast. It cost, as I recollect, about seventy-five cents a yard for the material placed on the track, and the work was done by a well-established contracting concern, who

made a specialty of doing that sort of thing, and we supposed we had something, but we found within three or four years that the ballast was practically of no use, and the reason may have been that the material was not proper or it may have been that it was not properly burned. I know that certainly was one of the conditions; at any rate, it had to be taken out and replaced by something else.

The President:—In reference to the cost of that work on a mile basis, I will state that our average figures on the Illinois Central, that we use in our estimates—of course, it differs on every division and for every year—but our rock ballast costs us from twenty-five hundred to three thousand dollars a mile on the basis of using approximately three thousand cubic yards to the mile, and a haul of from one hundred to two hundred miles for a completely ballasted track. Of course, that means where the track is put up with regular ballast and includes the surfacing and everything complete. With gravel ballast put up the same way it has cost as low as one thousand dollars, and as high as fifteen hundred dollars, a mile. The gravel ballast, however, includes the shaping up of the banks and the cleaning out of the excavations, in order to prepare the roadbed and crowning it properly for the ballast, so as to give it the proper drainage. The cost of the rock ballast, from an inch to an inch and three-quarters in diameter, is from as low as forty-seven cents to as high as fifty-five cents a cubic yard, loaded on board the cars, and twenty-five cents a cubic yard for the screenings, which are used to ballast city tracks and in the yards and for station platforms.

Mr. Sullivan:—I have noticed in the report on this subject that everything is considered with reference to it from a comparative or relative point of view, which, it seems to me, is only a partial view, and that there is necessity for going further. The order in which the subdivisions on ballasting are arranged places last on the list the one, "What constitutes ballasted track?"

It seems to me that that one should come first. In the subdivisions given in the report the materials come first and the Committee's treatment of them is altogether from a relative point of view.

During the last year I have been forcibly brought up against the limitations of the track, in connection with locomotive de-

signing and in connection with the use of the track in the operation of the road, and I don't feel any hesitancy in saying that from an operative point of view the officials of all roads having heavy fast traffic are directly against the limit, and it would be of great value if we could have some formula defining the limits of the track. We have nothing of that kind at present, and anyone who has to consider services approximating the limit of the track is left entirely in the dark as to what those limits are, so far as any definite statement of those limitations is concerned.

Now, my observation is that limiting conditions are not to be found in bridge designing or construction—the designing and construction of bridges can be carried so far beyond what is at this time needed or required that it does not enter into this question. The rail itself does not appear to be a limiting condition, because we are getting from the rail at present in use about all the service that is required, except, perhaps, as to the matter of economy, but as to the question of strain it seems to be ample. Ties are not a limiting condition, because there is nothing to indicate that the track cannot be made as substantial as the necessities may require, by increasing the size and number of ties, so that we are brought to the consideration of the ballast as a limiting condition.

It is generally held that stone ballast is the strongest. It is better than gravel, but how much better or what its limit is, I have never seen anything to indicate.

I have within the last six months had to assume the limit in the designing of passenger locomotives. The services of the road have called for a locomotive beyond anything that we have at present in use, and in fixing the limit of the design for the locomotive, the condition which appears to be the limiting one, after testing all the elements of the proposition, seemed to be the ballast of the track. To give an idea of what that limit has been assumed to be, I would state that instructions have been given to the mechanical engineers to get up a locomotive based upon the weights of 22,000 pounds per wheel, that is, the driving wheels of the engine, and speeds of from sixty to eighty miles per hour.

The result of the computation on those weights and the speed requirements is an engine weighing between eighty and ninety tons. An engine of that weight running at the speed will

naturally test something—but the traffic conditions are such that the operation must be conducted in that manner.

The importance of having a formula, if such a thing is obtainable, giving the absolute strength of the track, would be of great value.

Assuming, for instance, that the weight is underestimated and that instead of 22,000 pounds per wheel the track would stand weights of 24,000 pounds, the locomotive could be designed of greater efficiency, and when we consider that locomotives purchased to-day will render service for the next twenty-five to thirty years, if you underestimate the limiting conditions of to-day you are losing, for that entire period, just so much in the efficiency of your power.

The point I wish to call to the attention of the Committee is, if it is practical—there is a necessity and immediate use for a formula that will express the ultimate strength of the track or its limiting element, and if, as I assume, that limitation lies in the ballast, that is the point where we should commence by clearly establishing the limitation, and when that limit is ascertained or determined, the limits of the other parts will naturally follow.

I make mention of this fact because of the absence apparently in any one of these reports of the determining element, and would suggest that in consideration of the questions that the committees have to report upon that they will give the information establishing the absolute limit of track service.

The President:—Mr. Sullivan, as far as the ballast is concerned, there may be limitations in respect to the quantity of ballast that is now used, but I don't think there is any limitation in the efficiency of the ballast itself. It is simply a question of a proper quantity, and when you use the proper quantity to make your track strong enough for the weights and speeds which you have, you will find limitations in some other element of the track and not in the ballast. I think your point is very well taken, however, and that we should go into these things in a way to determine the limitations, but it would strike me that we ought to turn it around and that we men of the maintenance-of-way department should not place any restrictions or limitations upon the service of the road. If there are any ultimate limita-

tions, we should not acknowledge it until we have made an effort and a trial to overcome them.

Mr. F. S. Stevens, Division Engineer Philadelphia & Reading:—As to Mr. Sullivan's remarks—we have two passenger engines running with driving-wheel weights of 26,500 pounds.

The President:—We ought to hear a little more about the clay ballast. It is interesting to the South and the Southwest, and places where they have no other kind of ballast.

Mr. W. K. McFarlin, Chief Engineer Delaware, Lackawanna & Western:—As to burnt ballast, I would say, after having had considerable experience with it on our own lines, and watching it on other roads, it was first burned in 1884 or 1885. It was claimed that there was a patent on the process, which developed to be simply on the machinery for burning it.

As to the material from which burnt ballast can be made, gumbo is the best material, but clays can also be used. With whatever material it is burned, especially with gumbo, it swells to probably twice the size of the dirt used; that is, one yard of dirt makes two yards of burnt ballast. The average cost for burning is now about twenty cents per yard. It is light, and a car can scarcely be overloaded with it. If properly burned, you can take a piece of it and scratch glass, as you would with a diamond. It is very sharp, but still very light.

I consider it the best ballast made, if you have the proper material to burn it from, but on account of its lightness, it is not good for new track. It is so light that it will tend to crowd up between the ties on wet material. The ideal place to use it is where you have a fairly poor quality of rock ballast that is worn out. Put four to six inches of burnt ballast on that rock, and it makes ideal track. I have never seen burnt ballast heave in the winter, and I have never seen it when the water did not run freely from it. I refer, of course, to good burnt ballast.

You can get from three to five yards of ballast from a ton of slack, and you can use old slack or coal refuse in burning, but the better the coal, the better ballast you will get. As a gentleman has said, after the first rainstorm, the dust will not bother you. It never becomes so fine that it is not good ballast; it may be as fine as the end of a pencil, but still be fine ballast and clean. I have never seen weeds growing in it, and I speak after knowing it for ten or twelve years.

It is very easily handled and can be loaded with a steam shovel, and is cheap to transport. Of course, rock is good, but each country is limited as to what it can get, and in some localities there is no rock. In places where there is no gravel, gumbo is nearly always found and sometimes blue clay, which makes very good ballast, as I have stated, when properly burned.

Mr. F. H. McGuigan, General Superintendent Grand Trunk Railway:—I have had some experience with burnt clay, and agree with my friend, Mr. McFarlin, that it is a most excellent ballast, but am not prepared to say that it is the best ballast obtainable. During the years 1887 to 1895, we ballasted 225 to 230 miles of the Wabash Road between St. Louis and Kansas City with burnt clay, making a very good track.

On something over half the line we had a very bad roadbed. The gentlemen present who are familiar with that section of country will, I think, bear me out in saying that the divide between the Mississippi and Missouri rivers is the worst belt of country this side of the Rocky Mountains on which to maintain a track. The material generally is hard clay, so susceptible to the action of water, that it is exceedingly difficult to maintain open ditches, owing to its tendency to slide when wet.

We had little ballast except the top soil along the right-of-way, varying from six to eighteen inches, and a very inferior quality of limestone. We eventually succeeded in learning the process of burning clay for ballast, which after two or three years we were able to produce at about or a little lower than the figures given by Mr. McFarlin, as we purchased our slack coal at 25 cents a ton at the mines. The burning of the first fifty thousand yards contracted, cost us in the neighborhood of ninety cents per cubic yard, but as we learned from year to year how to burn, and the cost of doing the work, we were enabled to reduce the contract price to twenty-one cents per cubic yard, and I believe to-day the burning can be contracted in quantities of say 200,000 to 300,000 yards at seventeen to eighteen cents per yard—not including the slack, of which between 450 and 500 pounds is required for each cubic yard of ballast burned.

On account of the difficulty of maintaining the track we ballasted very heavily, using about 3,000 yards to the mile.

At our contract price in 1895—as I now recall it, twenty-one cents per cubic yard for burning—our ballast cost $1,200 to

$1,500 per mile, in track, complete, according to the distance hauled and condition of roadbed.

During the first two years that we used burnt ballast, in order to get authority to burn more, I frequently said to our people (and then believed it true) that weeds would not grow on it, but I afterward learned that they did grow upon it just as they will upon other ballast in time. Taking everything into consideration, it is by far the best ballast obtainable in that section of the country—in fact, it is the only ballast within reach of the railroads there. I do not, however, regard it as the best ballast for heavy traffic, because, as explained by Mr. McFarlin, of its lightness, weighing about fifteen hundred pounds per cubic yard. You will readily understand that there is not much resistance in such light ballast on an inferior roadbed where the curvature is excessive; hence, we frequently had considerable difficulty in holding the track in proper line.

Since going over on the east side of the Detroit and St. Clair rivers, our experience there has confirmed our previous belief that good gravel is not only the best, but the cheapest ballast on which to maintain a track under heavy traffic. I am sorry to say that I cannot agree with my friend of the Lake Shore that labor is all that is necessary to maintain a smooth track.

In his country, much of the roadbed on which the track rests is sandy soil, of excellent quality, making a fairly good ballast in itself, and requiring very little drainage; hence easy to maintain the track on. The same amount of ballast that would make a perfectly smooth track on the Lake Shore would not come anywhere near making a good track in the section of country between St. Louis and Kansas City, previously mentioned. It would require more than double the quantity of the same ballast to get the same results as on the Lake Shore Road. Therefore, I do not think it possible for this Committee to arrive at or prescribe any fixed quantity of ballast to be used—conditions vary so much in different localities.

Mr. Rockwell:—I do not want Mr. McGuigan to think that I meant that all that is necessary for good track is labor. First of all you have got to have drainage, and next after that I think you have got to have more drainage. If you do not have good drainage to your subgrade or to the groundwork for your ballast, you can not have good track anyhow. My idea of the definition

of a ballasted track is track that has ballast enough so that it will not churn, and we may have a small amount of ballast, or a large amount, according to the character of foundation that we have to put it on. What I said had simply reference to the surface finish of the track.

Mr. McGuigan:—During the summer of 1898, we ballasted forty miles of our line between Niagara Falls and Hamilton with gravel taken from the beach of Lake Erie—directly opposite Buffalo—the percentage of sand in which was so small (possibly fifteen per cent) that it was practically screened gravel. It made a very beautiful track to look at and for a time rode nicely, and is to-day almost entirely free from dust and vegetation; but it has disappointed us considerably, as it does not seem to hold the track in line, nor does the surface hold as well as with most of the gravel which we have loaded from other pits with steam shovel. This gravel from the lake beach, you will understand, differs materially from gravel loaded from the ordinary gravel pit, as it is composed largely of small pebbles with a light percentage of sand, without any bond or adhesive properties such as are found in good, average gravel.

Mr. C. S. Churchill, Engineer Maintenance-of-Way Norfolk & Western:—I am glad that the question of slag has been brought up by the Committee. This is a waste material on many sections and on many roads. We have used it for ballast with great success since 1890. Our road is one which is very plentifully supplied with limestone, which furnishes the best class of stone ballast. Nevertheless, the result of our experience with slag is that it is equal to the best stone ballast. We have sold several crushers, and are largely dependent, therefore, to-day, on slag ballast, of which we have large quantities along the line of our road. It has cost us about twelve cents on board cars. It is put on board cars at furnaces for above cost, delivered on track and put in same complete for a further cost of twenty-five cents per cubic yard; and we get good track, and we think superior track, in many cases, to what we get with the best hard limestone ballast. The advantage of glassy slag for use in ballast, when it is broken up fine, is very great, and we believe that the tendency of the roads will be to use more slag and finer stone ballast than has heretofore been used.

Mr. Stevens:—I think I can throw some light on this

question. We have fifty miles of road that have been ballasted with slag for more than forty years. The traffic has pulverized that slag from year to year, and dust has settled to the bottom, and to-day there are probably six inches to a foot of the cemented slag under those tracks that is almost as hard as stone. We are now ballasting tracks with stone. We have not sold our crusher.

Mr. Churchill:—There are different kinds of slags. There are some furnaces the slag of which we would not use—which it would be impracticable to use. But we have the glassy slag; it is usual to select that slag after the furnace has dumped it. Every furnace has a big output of slag; some is spongy in character and has free limestone in it. This is wholly unfit for use. The furnaces in Ohio turn out slag which we cannot use for ballast. There was some of this slag used for ballast in 1887, which we have been obliged to remove, but we have learned by experience the kind to select and the kind to abandon, and for that reason we know that we have several furnaces that turn out glassy slag, and we feel that we are independent of the use of broken stone. I do not say we have sold all our crushers. We have got a few we keep aside, so that we can use them in case the furnaces decide to charge us a little too much for the slag. Of course, we have got to look out for our interest in that respect, but we had, in 1,600 miles, eight crusher plants in 1887. Since that time we have dismantled a large number of them.

Mr. Stevens:—In this cinder or slag there is no great proportion of free lime, but the continual action of the track tools is perhaps what has caused this trouble. The ballast, when first put on, and perhaps for the first six or eight years, would be reasonably good, but the gradual disintegration for a long term of years has brought about this result. We are unable to use the slag selected on account of the extreme brittleness of the slag. We reject it for that reason.

Mr. W. E. Dauchy, Chief Engineer Chicago, Rock Island & Pacific:—I want to say a word more about what has been said about ballasting, and that is this: In selecting the ground, it usually happens that the gumbo deposits are on the creek bottoms, and the question of drainage during the burning process adds largely to the quality of the ballast we get. It frequently happens, if this question of drainage is not looked after closely, that

during the rise in the streams the pits are flooded, and the fires are put out, and that always results in getting an inferior quality of ballast, and I think that some of the prejudice against burnt clay ballast may be the result of some such experience.

Mr. D. W. Lum, Assistant General Superintendent Maintenance Southern Railway:—I would like, if possible, to arrive at an average between the statements of the gentlemen with reference to rock and slag. We have several hundred miles of slag ballast and perhaps a thousand miles of rock ballast on our line, and we find that the slag ballast does break up very fine under the tamping pick, and frequently collects as a fine powder at the ends of the ties, whereas, the rock does not do so and affords better drainage; and while the slag is very much cheaper and does, for the present, make very good track, it is our experience that the rock is more durable.

Mr. E. F. Wendt, Assistant Engineer Pittsburg & Lake Erie:—Our road uses slag exclusively for ballast. This material is used, not from preference, but rather because slag is given to railroad companies at Pittsburg without charge. In fact, the furnace companies have difficulty in disposing of the slag and are glad to get rid of it for nothing.

In discussing the use of slag for ballast we should keep in mind the fact that the term "slag" means anything from particles of dust to chunks the size of a football. The same blast furnace may make for a time a good hard slag fit for ballast; then again it may turn out slag which is practically dust and unfit for ballast.

Dusty slag will eventually cement its particles together and form a hard crust under the ties, a condition which results in very bad riding track. There is, however, a quality of slag turned out by some of the furnaces making Bessemer iron which varies in size from two to four inches on a side, which makes very fair ballast. When slag of this quality can be procured without cost it would not be economy to purchase broken stone at sixty cents per cubic yard. It must, nevertheless, be understood that slag is very expensive ballast to unload and place under the track, as every man knows who has used it.

After using slag for ten years, our opinion is that it is inferior to broken stone for ballast and a proper gravel is certainly preferable to either stone or slag.

The President: Mr. Lum, what is your experience in reference to using slag for a foundation ballast and covering it with rock?

Mr. Lum:—We have done that in some cases, but wherever possible we are using rock, as we consider it much better.

Mr. Hutchinson:—I believe the Reading Road was the first road to use slag as ballast. In those days, when they began to use it, there was more iron in the slag when it came from the furnace than there is now, consequently the slag was pretty hard and made pretty good ballast, but as furnaces run now, the quality of slag ballast has deteriorated.

Right after my friend Stevens began, they used a smooth kind of slag. By the time we got there, the good slag had been used up for the Reading, and they to-day are using the new kind. We put it in very extensively in 1888, and to-day I think there is not a mile of slag-ballasted track on the Schuylkill Division. They found exactly the trouble that Mr. Stevens and Mr. Lum just described.

Mr. Stevens:—I want to say further that we did not abandon the use of slag on account of any other reason than purely to avoid this trouble, for this furnace cinder did not cost us a cent—the furnace delivered it on the cars to us, to get rid of it.

Mr. Churchill:—Answering the question of the President—I have not had experience with the use of slag over stone. Answering the previous speaker—I think that the whole difference between Mr. Stevens and myself is really covered by the proper selection of the slag to be used.

We have been through the whole matter ourselves, and I also was on the Schuylkill Valley Railroad, and had something to do with the building of it. Further, I am acquainted with the Reading Railroad, and that character of slag we would not use. Therefore, I say, it is a matter of selection just the same as the choice of a gravel pit is controlled by its quality. If you have not the right kind of slag on your road, it should not be used for ballast any more than one should use cementing gravel. However, it is an easy matter to determine the proper slag for such use.

Mr. Wilson:—I think we are probably spinning out this subject of slag ballast unnecessarily. If the Committee, in treating this subject as specified under No. 1, "d," as slag, cinder and burnt shale, will also add as under "a," size and quality, it will

then give these gentlemen more opportunity to agree, as their disagreements seem to be upon these two last points and upon the question of quality seems to depend the entire question as to whether slag should be considered as a fit ballast to use.

The President:—Our time is being used up and while this discussion is very interesting, after calling on Mr. Peddle, we will close the discussion.

Mr. Peddle:—I want to thank the gentlemen for the information gained this morning. After all, the question of standard ballast depends on the payrolls.

The President:—We have four other important committees to hear from, and it will probably take about two and one-half to three hours, and it is now one o'clock. It is a matter that we would like to have the Association decide as to whether we shall take a long recess or a short one. It seems to me that instead of cutting off these discussions, we should have a full expression from all our members. When we get into an interesting discussion, as we have had on this ballast question, we should not be compelled to give it up or to cut it off on account of lack of time. I think it is possible that we could devote at least two or three hours more to the discussion.

The Convention then adjourned until 2:00 p. m.

THURSDAY AFTERNOON SESSION.

The President:—Will some member of that Committee please call the attention of the chairman (who is not present) of the Interlocking Committee to the question of taking up and getting information as to the State laws on interlocking requirements and on grade crossings and signals? It has been suggested and is a very important fact that we have overlooked, that a great deal of committee-work might be thrown away provided it did not correspond to or meet the requirements of the State laws in some of our States, and that the work of the Committee in the compiling of these laws and conditions might enable us a little later on to take up the matter as an Association with the commissions of the various States, so as to get laws that will be uniform and practicable from an operating standpoint.

Mr. D. D. Carothers, Engineer Maintenance-of-Way Baltimore & Ohio Southwestern:—It occurs to me that on account

of the limited time that we have it might be possible to do away with the reading of the papers, as they are now in the hands of all the members, and they have had sufficient time to look them over. I move, therefore, to dispense with the reading of the papers.

The motion was carried.

REPORT OF COMMITTEE IV.—ON RAILS.

To the American Railway Engineering and Maintenance-of-Way Association:

The railroad mileage of this country at the end of the year 1898 is reported at 187,000 miles, with 245,000 miles of track. The expenditure in 1898 on account of maintenance-of-way and structures is given as $160,000,000—about 21 per cent of all operating expenses. The expenditure on account of rail, based on figures for the past five years, would be about $14,000,000. This does not represent the amount paid mills for new rails, as that amount is credited by amounts received from sale of scrap and old rail applied to construction of sidings, etc. It would appear fair to estimate that about $25,000,000 is paid out per year to the rail mills by our railroads.

A glance over the maintenance-of-way and structure accounts indicates that expenditures on account of rails come second to cross-ties, and, taking into consideration the large amount involved, an increase of one year in the life of our rail means a considerable saving. On account of the sharp competition for traffic, low rates, and the necessity of bringing down the transportation expenses to meet the constantly decreasing rates, the rail question may be considered to be one of prime importance.

It is the duty of the engineer to use such materials as shall be economical both in original cost and maintenance. The two items of original cost and maintenance are very closely related. If we now pay $33 for a rail lasting, say, ten years, it is costing us $3.30 per year; if, by paying $34, we could get a rail that would last eleven years, it would cost us $3.10 per year, showing we can well afford to pay the addition of $1 per ton to get an additional year's life. So we see that there is possibly no problem worthy of more attention than the one of economical wear and service of steel rails.

This Committee has received a communication from a member in Canada, asking the help of your Association toward securing better rail. His railroad is buying from the States; the rail is soft and wearing badly. The mills have been asked to give better rail, and the reply is that the railroads in the States are using the same rail, and what is good enough for the States is good enough for Canada. Your Committee is also of the same opinion as the mills, "that rail good enough for the States is good enough for our brother in Canada." Do not our trains run as fast, and are not our engines and carloads as heavy? And this brings the

issue squarely before us: Is the rail now furnished by the mills of the States good enough for the railroads of the States? If this Committee could conscientiously answer yes, then it might congratulate itself on having an easy life ahead; but we cannot, however, concede the truth of the statement that the rail we are now getting is good enough, and we will, therefore, aim to make such practical suggestions or recommendations as shall help toward a solution of this vexatious problem.

It may not be out of place to call attention to the fact that many well-meaning efforts at reform have been in vain, on account of the very radical position taken by some of the persons connected therewith. Therefore, if any of us incline to extreme views in such matters as high carbon or low carbon, let us find at least some common ground on which we can take a stand, and then we shall make headway, possibly slowly, but surely. If we agree on uniform sections on all our lines, we will eventually save for our companies, and, possibly, in addition, increase the profits of the rail manufacturers, about which so much talk has been heard in Pittsburg recently. Let us agree on one other thing—that the mechanical treatment in rolling and the temperature at which the rail is finished is of the greatest importance—then insist on the mills making an improvement in this regard.

If this Association can agree on a specification for the manufacture of rail, which may not be perfect, but which will be a step in advance of what we are doing, have it approved by our companies and accepted by the rail manufacturers, decided progress will have been accomplished. It would appear better that we should attain our goal by making two or three steps, if necessary, as we are able, rather than by trying a big jump and fail.

History.—The Committee deems it proper in this preliminary report to give a brief resumé of the facts in regard to the evolution of our present rail. It is said that railways are as old as civilization, reference being had to ways adapted to the passage of wheeled vehicles. Wagons were used in Egypt at a very early day. No doubt railways or tramways were used in the construction of the Egyptian pyramids. Wooden railways are said to have been used in the mining districts of Germany from time immemorial; they were introduced into England as early as 1602, and to this country we are largely indebted for the development that has taken place.

The wooden tramway was the first improvement over the ordinary road.

1602.—In a history of coal mining at Newcastle-upon-Tyne we find a complaint of "badness of the roads by which the loads of carts were reduced."

1649.—On the authority of Nicholas Wood, who mentions a book entitled "Chorographia, or a Survey of New Castle-upon-Tyne," published in 1649, credit is given to a South Country man named Beaumont, who introduced wagons which ran on tramways. We are told Mr. Beaumont expended thirty thousand pounds in improving ways and wagons, etc.

1676.—Roger North, in "Life of Lord Keeper North," Vol. I., p. 265, states that at Newcastle-upon-Tyne, in 1678, among the curiosities of the place were "Way Leaves," or "Ground Let for Laying Wooden Tramways On." These consisted of single wooden rails of timber, straight and parallel.

1700.—Double wooden rails used; that is, a second longitudinal was spiked on top of first stringer.

1737.—Cast-iron plates used on face of wooden rail to obviate rapid wear.

1750.—Cast-iron wheels in use.

1765.—We hear of regular constructed railways, with special works, cutting and filling, with wooden rails seven inches square, resting on cross-sleepers four feet apart.

1767.—Cast-iron rails first made at Colebrookdale Works, in Shropshire, five feet long, four inches wide and one and one-quarter inches thick, each rail having three holes to fasten. Mr. Nicholas Wood, in his book on railroads, 1825 edition, says: "Mr. R. Stephenson, whose inquiries with railroad conveyances have been pretty extensive, states: 'I some years ago visited the great iron works of Colebrookdale, in Shropshire, where cast-iron was indisputably first applied to the construction of bridges, and, according to the information which I have been able to obtain, it was here also that railways of that material were first constructed. It appears, from the books of the extensive and long-established company, that between five and six tons of rails were cast on the 13th of November, 1767, as an experiment, on the suggestion of Mr. Reynolds, one of the partners.'"

1770.—Wooden rails have rounded tops, with wheels cast-iron, hollow to fit. Outer flanges rejected.

1776.—Cast-iron railway at Sheffield, two flanges projecting upward; both flanges of wheel dispensed with.

1789.—An organic change comes with the Jessop edge rail, so-called from being narrow and deep, which again restored inside flange to wheels. They were cast-iron bars, three feet to four feet long, web one-half inch to three-quarter inch thick, swelling out at head to two or two and one-half inches.

1792.—Chairs for rails appear.

1797.—Plate rail, with flange turned up like an angle; later improved with fish-belly.

1800.—To this date the rails were laid longitudinally on cross-sleepers at intervals of three to five feet. Ostram used stone sleepers instead of wood cross-ties, giving name Ostram roads, after abbreviated tramroads.

1803.—The Surrey Iron Railway, the rails were three feet two inches long, rectangular plates of cast-iron four inches broad on the tread, one inch thick, except for five inches or six inches at each end, where they were one-half inch thick; below was a rib or fish-belly about two feet long for additional strength.

1808.—Malleable iron used at Walbottle Colliery, near Newcastle. One hundred and fifty years of engineering experience required to advance from timber, laid down to prevent wheels sinking into the mud, to an iron rail and iron wheels, something like mode of present day.

1811.—Wrought-iron rails in use.

1820.—The Bedlington Iron Works rolled rails fifteen feet long, after designs by Birkenshaw.

1825.—Stockton & Darlington Railroad opened September. Construction consisted of fish-bellied rails, twenty-eight pounds to the yard; points of support three feet apart.

1831.—Camden and Amboy partly laid with Stevens rail, commonly known as Vignoles, the design being erroneously attributed to this French engineer, who introduced it into England. This rail was rolled by Dowlais Iron Works, Cardiff, Wales, five hundred rails, eighteen feet long, thirty-six pounds to the yard, being shipped to Philadelphia in 1831. This type almost universally used in this country and in Europe.

1835.—Experiments by Barlow led to abandonment of fish-bellied rail in England and substitution of rail with parallel faces.

1837.—Double and equal headed reversible rail, invented by Joseph Locks and used on Grand Junction Railway.

1844.—First rail rolled in America at Mount Savage, Allegheny County, Maryland, being U-shaped, weighing forty-two pounds to the yard, and laid on longitudinal wood sills.

1856.—First Bessemer rail rolled. The behavior of these first rails was unsatisfactory and manufacture was abandoned.

1864.—Manufacture of Bessemer rails resumed.

1872.—Manufacture of steel rails in the United States, largely increased about 1875.

1892.—A. S. C. E. sections adopted by the American Society of Civil Engineers, and may we not add—

1900.—A. S. C. E. sections adopted by this Association?

SECTIONS.—The railways of the United Kingdom are almost universally using the bull-headed steel rail, keyed into chairs fastened to transverse sleepers, while in America we use flat-bottomed rails, resting direct on transverse sleepers.

In a paper reported by William Hunt, Chief Engineer of the Lancashire & Yorkshire Railway, read before the International Railway Convention of 1895, we find the following:

"The Engineer of the Great Northern Railway of Ireland, comparing our American practice with the English, says: 'As the steel rail (American) is immediately in contact with the sleepers, the result is a very smooth-running road; at the same time there is no doubt that our steel bull-headed road, with the chairs keyed inside, is far superior, stronger, more permanent and better in every way than any flange railroad.'"

The Chief Engineer of the New York Central Road, reporting on the American type to the same body, says: "Rails supported in chairs have

been out of date in this country for many years past, the Vignoles type or flange rail, as it is termed in this country, having proved immeasurably superior in service and economy on American railroads."

The Committee, being of the opinion that the A. S. C. E. sections are a step in advance, thinks that no new sections should be suggested until we have had full time to learn from experience the merits of these sections. It is recommended that all members of this Association, whose lines are not using these sections be urged to have them adopted and used on their lines. The results should be carefully compared with results from the old sections. Mr. Manning writes us that "the A. S. C. E. sections are by far the best, with the exception that the head should be a little deeper for rails under ninety pounds." Of course, you all know that Mr. Manning has a section of his own for curved track, which he thinks can be applied to a straight line also with good results. The percentage of curved tracks on a majority of lines is small, so that, in the opinion of a majority of the committee, no additional sections are needed to meet the situation.

Referring again to the A. S. C. E. sections, we must always bear in mind that the best results from these sections will not be obtained until better work is done at the mills, and this brings us to the chemical constituents and the mechanical treatment, the latter being probably the more important.

CHEMICAL CONSTITUENTS.—Experiments are being conducted on a small scale with open-hearth nickel-steel, Bessemer nickel-steel, and high and low carbons. These special rails are very high-priced, and, in the opinion of the Committee, are not likely to come into general use—at least for some time. We do not consider it advisable to treat this matter at length at this time any more than to call attention to the fact that in many cases of rails giving good service we have to look beyond the chemical constituents, as we shall see later. Your attention is called to an abstract from the Railroad Gazette of November 24, 1899, on hard and soft, or high and low, carbon rails, as follows:

"Quoting the results of experiments on the Netherlands State railroads, in which sixteen German rails were made from four different charges, two of which contained 0.38 carbon and two 0.21 carbon. After 1,833 days' service these rails were reweighed and the loss of weight in the case of the soft rail was 28 per cent more than in the case of the hard rail. After 3,787 days' service they were again reweighed, and found that the hard rail had lost 14 per cent more than the soft rails, with total results, after 5,620 days and 91,459 train movements, the soft rails had lost four per cent more than the hard rails.

"In addition to this twenty-two Belgian rails were laid, made from six different charges, three of which contained 0.45 carbon and three 0.25 carbon. After 2,040 days' service the soft rails had lost 29 per cent more than the hard rails, but in the next weighing, after 3,635 days' service, the hard rails had lost 5 per cent more than the soft, with a total result that, after 5,675 days' service and 98,938 train movements, the soft rails had lost 7 per cent more than the hard.

"In the first reweighing the hard German rails lost, per metre and per 10,000 trains, 133 grammes, while on the second weighing they had lost only 91 grammes per metre and per 10,000 trains. In the soft German rails these losses were respectively 170 and 80.

"With the Belgian rails, at the first reweighing, the hard rails lost 121 grammes per metre and 10,000 trains, while on the second reweighing they had lost 98 grammes. The soft rails had lost 156 grammes per metre and 10,000 trains in the first period and 93 grammes on the second period."

Attention is called to a paper by one of the members of this Committee, Mr. Hunt, some years ago, in which he brought out the fact that rails with widely different chemical components gave equally good service.

MECHANICAL TREATMENT.—The rolling of the rail is of the highest importance. The best American rails appear to have been made about 1880; there was then no good uniformity in chemical constituents of Bessemer steel; it varied widely, but such variation had but little influence on the wear of the finished product. In order to determine why the rails gave good service, we must, therefore, look to the methods of manufacture, and the molecular structure of the steel resulting from these methods.

The following description of the old and new methods, with some deductions, is quoted from a letter of Mr. Reed, in charge of a rail-sawing plant at Wheatland, Pa.:

"In 1880 the usual Bessemer practice was as follows: In the blast furnace, ores naturally low in phosphorus and sulphur were used, the iron was produced much slower than to-day; after being cast into pigs it was allowed to cool—come to rest, molecularly—then selected on its chemical analysis, remelted into cupolas and blown into converters in smaller quantities and also slower than at present, and, it is fair to assume, was more thoroughly 'cooked' and combined with its alloys. The resulting ingots (fourteen inches square) were allowed to cool—to come to a molecular rest—were stripped of their molds, and were then charged into horizontal furnaces, where they were heated much slower than now, and not so hot as present practice compels. When heated they were bloomed down to seven inches square, in thirteen passes keep in per pass through the rolls. These seven-inch blooms were then allowed to cool—come to molecular rest—and then charged into another heating furnace, again being heated more slowly than in present practice, and then were rolled into rails of somewhat less average weight (say, seventy pounds) than at the present time. Using a smaller bloom than now, even though making generally a lighter rail, there was less reduction of work necessary in the rolls, but it was slowly done, as forty-nine square inches of bloom were reduced to a seventy-pound rail in thirteen passes in a train running four hundred feet per minute. As a result of this deliberate and thorough working the steel was never subjected to violence, and was finished cooler, and this had a most salutary effect on its molecular structure."

Comparing this old practice with that now in use, we find as follows:

"In the blast furnaces, ores both high and low in phosphorus are

used—that is, some extremely low and others above the normal, as compensated—and the furnaces are driven at a high rate of speed. The metal, when reduced, is run, fluid, into a 'mixer,' but is never allowed to come to rest or cool. From the mixer it goes, still fluid, to the converter, and is blown hard and rapidly in less time than before and in larger amount. Then it is cast into ingots, which are not allowed to cool or come to rest, but are at once charged into heating furnaces, and held there until ready for blooming. They are then, with their contents in an unknown state—sometimes fluid, semi-fluid, pasty or granular—passed to the blooming mill and reduced from sixteen by eighteen inches (an average, modern-sized ingot), having 288 square inches of area, to a bloom eight inches square, having sixty-four square inches of area, which is a reduction of 224 square inches, in eleven passes, or 20.4 square inches of reduction to each pass (instead of 11.3, as formerly), which is nearly 100 per cent faster, in addition to which the train is nowadays driven at a higher rate of speed than formerly. The eight by eight bloom thus produced is not allowed to cool, come to rest, and readjust its outraged and crushed particles, but is charged into a heating furnace and held hot, or in some cases proceeds without further heating direct to the rail mill, where it is reduced to a seventy-pound rail, in nine passes (instead of thirteen), by rolls running 900 feet per minute, instead of 400, as formerly, which is over 60 per cent more reduction, pass for pass, leaving out of consideration the speed at which it is done, which has an important bearing on the final result. Owing to all this haste the rails finish at a high temperature, and the heads practically anneal and soften themselves on the cooling beds, but the annealing is useless and too late, as the mass of metal in the heads is, of course, open, friable grain and poorly fitted to stand the abrasive action of car wheels under heavy loads."

When steel is allowed to cool without being subjected to work it takes on a coarse, crystalline structure. If it is subjected to work while in the plastic state the crystallization becomes smaller, as the work is done at successively lower temperatures, until we reach the recalescent point.

The main difference between the present and former mill practice in making rails consists in a fewer number of passes and faster speed of train by which the finished pass is reached, while the metal is still at or above an "orange" heat (2,000 to 2,200 degrees Fahrenheit). Whereas, in the older practice, with more passes and slower speed, it was finished at a "cherry-red" heat (1,400 to 1,600 degrees Fahrenheit). The modern rails, as shown under the microscope, have a crystalline structure in the head, which cools last. The larger the section, the slower the cooling and the coarser the crystallization. Rails finished at a dull red heat (1,300 degrees) have a finer granular texture throughout, as shown by experiments made by the Carnegie Steel Company.

It is our opinion that the wearing quality of the rails will be improved by taking more time for the finishing passes at the rolls.

This does not mean that the speed of the rail mill need be reduced,

but that provision be made for holding a number of rails at a certain stage in the rolling, allowing them to come to a certain temperature, which will also mean that the heat retained in the rails will be distributed uniformly throughout. The rails are then taken in the order in which they have been held, and the finishing passes are taken at a lower temperature than present practice. Your Committee understands that patents have been taken out, covering this improved method of rolling, and that in the near future we may expect rails with more work on them, insuring a better wearing surface and a better wearing rail.

LENGTH OF RAILS.—There is probably more diversity of opinion at the present time on this point than any other. We have been advocates of 30-foot, 33-foot, 33-foot 4-inch, 45-foot and 60-foot rails.

The transportation difficulty has been the governing feature in fixing at thirty or thirty-three feet, the latter being considered the longest rail that can be handled conveniently in present length of cars. The advocates of forty-five foot rails think forty-five feet about the maximum length that can be used with reasonable close-joint spacing. Then we have the sixty-foot rails, taking out 50 per cent of our joints.

It is the experience of a part of the Committee that sixty-foot rails can be laid with most excellent results on lines of easy grades and light curvature, with joints much closer than used in the average practice. It is believed that the best results will be obtained with sixty-foot rails when anti-creeping devices are used at least every thirty feet.

The care of rail in laying, and after laying, although of very great importance, is possibly second to some of the items mentioned.

Thousands of tons of rail have been taken out of the track after short service on account of battered ends, due to improper and wide spacing at joints. If your track is well and full ballasted there is little trouble to be anticipated by laying pretty close joints. If, however, you lay close joints and have your track half or quarter ballasted, look out for bad results in very hot weather.

These matters will receive more attention from the Committee at a later time.

SPECIFICATIONS.—The Committee will recommend to your Association a standard specification for general adoption.

IN CONCLUSION.—The very complete syllabus prepared for the Association fully covers the ground, and the Committee has nothing to suggest in addition to that syllabus. The Committee has given some thought to the manner of laying rail, use of relieved rail, etc., and these matters will be brought to your attention in future reports.

R. TRIMBLE, Principal Assistant Engineer Pennsylvania Lines West, Pittsburg, Chairman;
S. M. FELTON. President Chicago & Alton, Chicago, Vice-Chairman;
A. W. JOHNSTON, General Superintendent New York, Chicago & St. Louis, Cleveland;
THOMAS PURCELL, Superintendent Mexican National Railway, Matamoros, Mex.;

W. T. MANNING, Consulting Engineer Baltimore & Ohio Railroad, Baltimore;
C. E. WICKHAM, Division Engineer Chicago, Rock Island & Pacific, Chicago;
R. W. HUNT, Consulting Engineer, Chicago;
J. H. WALLACE, Assistant Engineer Maintenance-of-Way Southern Pacific, San Francisco;
G. B. WOODWORTH, Rail Inspector Chicago, Milwaukee & St. Paul, Chicago;
Committee.

The President:—The Rail Committee is represented by Mr. Johnston, Mr. Hunt, and Mr. Woodworth, and as we may want to ask this Committee questions, and it must have a head, in the absence of its chairman and vice-chairman, we will place the Committee in charge of Captain Hunt. The subject is now open for discussion.

Mr. E. E. R. Tratman, Resident Editor "Engineering News":—I would like to make a suggestion as to historical record, under date of 1831. It has been said that the Stevens rail is the invention of a French engineer, Mr. Vignoles. I think it has been pretty thoroughly proven, authoritatively, that Col. Robert L. Stevens invented that in 1830. The rails were rolled in 1831, and it was not until 1836 that Vignoles brought out his rail. He may not have known of the Stevens rail, it may have been simply a reinvention, but I think that the paragraph should be revised to give Stevens, the American Stevens, the credit for that rail. At the end of the historical record, also, reference is made to the adoption of standard rail sections by the American Society of Civil Engineers. As many of us here are members of that Society, it is hardly necessary to state that the Society has no standards, for rails or anything else. The sections referred to were recommended by the Society's Committee on Rail Sections, in its report in 1893, and the report was accepted by the Society. That Society may recommend certain practice, but does not adopt standards.

The President:—I presume the first question you will want to ask Captain Hunt is, "Why do we not get better rails?"

Mr. P. A. Peterson, Chief Engineer Canadian Pacific:—I wish to ask Captain Hunt a few questions. I would like to know

why we do not get as good rails as we did in the olden days. We have fifty-six-pound rails in our road that were laid in 1875, of which there have been very few broken, and we run our heaviest engines over them at sixty miles an hour. I would like to hear from Captain Hunt why these rails are better than those we get at the present day, weighing eighty pounds to the yard.

Captain Hunt:—I think I have gone on record so many times as to my belief covering the causes of the present heavy section rails being unsatisfactory—that is, comparatively unsatisfactory—and why the modern rail does not give as good results as you obtained from the original steel rails or those made in the earlier days of the Bessemer manufacture, that it seems to me anything I should now say would be trite. At the same time, if you will allow me, perhaps some of you gentlemen do not know that it is my fortune to have been connected with the manufacture of Bessemer steel ever since it was introduced in this country, and my living for a great many years has been made in connection with it. Naturally one takes particular interest in the sources from which their bread and butter is derived, so that, if no other reason, has caused me to study the steel problem.

The effect of work on steel is absolutely regulated by the heat condition of the metal when it is performed, so it is easy to appreciate why a rail made under existing conditions should not be the same as one made in the past, even though the composition of the steel be the same.

I suppose all of you are familiar with the experiment, and if you are not, I ask you some day to amuse yourselves by trying it, by going into a blacksmith shop and taking a bar of steel—have the smith put it into the fire and bring it up to as high a heat as that piece of steel will bear. Naturally, the end of the bar which is in the center of the fire will be hotter than as it goes up toward his hand at the other end. When he brings it out, if he will quickly mark it every inch with a nick, and then lay it down and let it cool, and when cold break it at those nicks, it will give you a very complete record of the heat to which that steel has been subjected. It will not have received

any work or been influenced in any way excepting through the temperature to which it has been exposed. You will find that a piece of fine-grained has been changed to a coarse-grained steel, and it will gradually approach its normal condition where it was not heated at all. There is the whole secret. If you form a piece of steel into a rail and perform work upon it at a very high temperature, you are bound to have a coarse-grained piece of metal, and it goes without argument that a body of steel so constituted cannot resist abrasion as well as close-grained. It cannot resist any kind of strain as well as one where the crystals are minute, and, hence, more closely allied and stronger in their character. Under the old conditions the word "steel," as applied to a rail, carried with it the same intimations, or the same controlling influence on the worker that he had been accustomed to consider in the handling of the old grades of steel. It was supposed that Bessemer steel would not bear a high heat. Steel rails were rolled, originally, in rail trains, which had been used for making iron rails, some little change being made in the grooves in the rolls. The reduction was made on the same sized trains, the same sized engines—all machinery just the same. They thought they could not heat rail steel to a high point. The practice used to be that before the steel blooms were charged or put in the furnaces the doors of the furnaces were raised, and the interior of the furnaces brought down to a low heat. Then the temperature was increased very gradually, quite an hour and a half being taken in bringing the steel up to a heat sufficiently high to permit of its being rolled, which was not much hotter than those rails that you saw yesterday drawn from the furnace of the McKenna mill. Then, with some thirteen to fifteen passes through the rolls, the reduction was performed very slowly, very carefully. If there was a flaw discovered, the process was interrupted—the flaw chipped out. One man held the chisel with a long handle, while another man with a sledge would strike. He would go to the bottom of the flaw, and then the rolling would be resumed.

Now, this work being performed by this comparatively weak machinery, the result was that the rolls were constantly breaking and there was not the power required. The natural thing was to find out whether the steel would not bear more

heat, so that it would not be so hard, and thus roll easier, and to the surprise of the manufacturers it was discovered that it could be brought to a heat that would almost allow the cinder to start on it, and it would not go to pieces.

We will assume there were seven or nine blooms placed in a heating furnace. I have seen, many and many a time, that the bloom next to the fire would be brought out when it would be so hot that when we made the first pass at the rolls it would go almost into powder. It would crumble up like sand, and you would have to take it up with a shovel. The heater would then take another bloom from the other and cooler end of the furnace, and, if it rolled, he would work from that end back toward the hotter one.

This experience led to the general practice of working the steel as hot as it would stand. Heavier machinery was gradually adopted, but with its introduction the number of reducing passes were lessened. Experience proved that too highly-heated steel gave bad rails, and therefore nearly the original care was given. But then came competition. The railroads, through stress of hard times, reduced the size, or absolutely cut off their orders. So came the desire, the necessity, for cheapening production. This went on during dull times, and when the rush came, through brighter business conditions, volume of production was the thing most considered.

As you have increased the section, so have you increased the effect of heat. If you keep on, you will presently have a piece of steel in your rail head that is in character no better than the old 7x7-inch bloom, from which your original good rail was rolled—a different shape, but absolutely the same as to the physical character of the metal itself. Now, it is impossible for that to give as good results. How it is going to be altered is not as easy a question as perhaps might be thought by one who has not had experience in the matter. You, gentlemen, or at least those of you who control your appropriations, have seldom shown a willingness to pay any more for a rail because there was a supposition that it would prove to be better. Many times twenty-five cents a ton has thrown the work from one place to another. There was a little while that more money was paid for supposed extra quality of steel. That lasted, I think, for one or two orders. Competitors came in and said

they would make the same kind of steel at the market price. Their word was taken before enough of the special rails had been rolled to give a fair trial. The cheap prevailed. So the manufacturers have not been entirely to blame. Notwithstanding the wonderful profits which we have been reading of in the newspapers, of one organization at least, I know there was a time when money was not generally made in the steel-rail manufacture in this country. The best evidence of that is the wrecks that we find scattered along the way—the millions of dollars that were lost in the industry.

Now, if you will for one moment reflect on the conditions to-day: From the time that the ore and the fuel and the limestone are charged into the blast furnace until the rail is put on the cars—at least until after it leaves the straightening press—the metal has never become cold. It has not had an opportunity to cool, so that Mr. Whittemore's statement that the metal is squirted through the rolls is not so far off the truth, because there are thousands and thousands of tons of rails rolled in which the metal has scarcely solidified before the final passes in the rolls.

We can recommend specifications for your adoption, but what good is it going to do, unless there is a concerted movement on the part of the purchasers of the material that they will insist on the specifications being adhered to? If they are convinced that they are good ones, and if it is logical and true that following them will legitimately increase the cost of manufacture, the railroads of the country ought to be willing to pay the proper price for the rails. This would be only fair to the manufacturers.

But I think myself, as intimated in the present report, that it can be brought about without any great increase of cost. The Committee contend that the makers can do it without going to great expense in the reorganization or organization of their plants—for instance, to regularly practice that which has experimentally seemed to have accomplished good results; that is, that after the rail is practically formed, before it gets its last work, that it shall be held long enough in its partially finished condition to lose sufficient heat so that the last reductions will be given it at a low temperature.

All we can do, gentlemen, I think, is to formulate good specifications and submit them for the consideration of this organization and its indorsement, if we can convince you, and so bring its pressure to bear upon the commercial conditions of the matter. You will recall that it took five years for the Americal Society of Civil Engineers to agree upon the rail sections, which are practically the standard to-day. It is not likely that our specifications can be drawn up in a short time, but in my opinion it is a legitimate and important matter for our organization to pass upon.

I am a member of an American organization which is seeking to agree upon specifications of all kinds to submit to an International Association as American specifications. I have taken the position that (as unfortunately the organization to which I am now alluding is composed almost entirely of the representatives of the manufacturers of the country) they are not the people to put before the world what are thought to be the specifications representing the American ideas and American desires. It is right, of course, that the manufacturer should not be ignored. It would be foolishness for a man to design a locomotive, no matter how proficient he might be in the higher mathematics, and not consult an experienced mechanic in regard to its details; and so it would be very bad judgment to prepare specifications for the manufacture of any material and not take the manufacturers into consultation. You should know just how your plans will affect the cost, and you ought to be frankly told why it is going to increase the cost if it will do so; but I say, the users of material should be the ones who should specify. If you buy a suit of clothes, you do not want to take homespun if you think you can afford to pay for broadcloth. So I do not think the buyer should be absolutely controlled by the man who has the material for sale. I think, in the case of the buyer of steel rails, he should have the right to say what he wants, pay what they are worth, or else leave the details of their making alone and cease complaining.

Mr. Peterson:—It seems to me that this Association can do a good work in organizing a means of controlling the manufacture of a great majority of the things required on railways, such as rails, joints, spikes, tie-plates, etc., etc.

At present the manufacturers control the railway officials, and we have to take what they are prepared to give us. If we hand the manufacturers a specification of what we want, they tell us plainly that they will not work to it, and that we must take what everybody else is taking, or go without it.

In order to overcome this, we must agree upon specifications, and then we must stand together and all refuse to take any articles that are not up to the requirements of our specifications.

I can quite understand the manufacturers refusing to work to as many different specifications as there are railways in the country; but, if we can all unite on one specification, we shall certainly be able to get what we all want, and to get rails made of the best materials, and with sufficient work put upon them, so that they will, at least, equal the rails that were rolled twenty-five years ago, and are still rendering good service in our railways, while rails that were rolled last year are being taken out of the track on account of splitting, flattening and crushing. Many of us have tried to get the manufacturers to give us better articles and have failed; but, if we can all agree as to what we want, we shall surely get it—and this I consider should be one of the principal aims of our Association. It will enable us to meet the manufacturers on even terms, and there is no question but that, if we all unite, the manufacturers will have to come to our terms.

The President:—Mr. Peterson is right. The situation is very much like that presented by the waiter girl in the country hotel, who said to a guest, "Will you have tay or coffee? We have no coffee—you will have to take tay."

Now, we have to take the rails the manufacturers choose to give us, and if we make specifications, as Mr. Peterson says, for one road, and our manager attempts to get the steel company to accept them, they will not do it, and there is no way of making them do it. In union there is strength, and that is the strength of our organization. One reason why this Association put Captain Hunt on this Committee was that he could advise with us. We have to pay him for inspecting our rails, anyway. He can tell this Committee and advise this Association what is practicable for the steel manufacturer to furnish, and about how much it would increase the cost, so that we would not simply get up a scientific theoretical specification that the manufacturers did not

have the ore or the metal to fill, or which was impracticable to work under. What we want and what we need is the best product that we can get from the steel rail mills at an economical cost.

We would not be warranted in paying $100 per ton for steel rails that last twenty-five years if we can get steel rails that will last twenty years for fifty dollars a ton, or that last fifteen years for twenty-five dollars a ton. It is economy that we are after. If the poorer article is more economical for several years, though maybe it is not technically the best rail, it is the economically best rail that we want.

Mr. McFarlin, Chief Engineer Delaware, Lackawanna & Western:—Mr. Hunt seems to criticise the mechanical part of the present rail construction. Does he also criticise the chemical construction?

Mr. Hunt:—That will be governed largely by geographical conditions. It is perfectly easy for the manufacturers east of the Allegheny Mountains to give a low proportion of phosphorus, and it is impossible for those west of the Allegheny Mountains; that is, taking as an illustration Scranton and Harrisburg as two manufacturing points. Their cheapest ore comes from Cornwall, Pa., and therefore they use pig-iron from there. It is cheapest, and it also happens that the ore is low in phosphorus, hence they can give a steel specification where the phosphorus is limited to .05. When you go West, where Lake Superior ore is largely depended upon, it is an impossibility. There are low phosphorous ores in that region, but they are scarce. There is no supply to meet the demand. It would soon be exhausted, and the commercial state of the question to which our Chairman alluded comes in.

Answering Mr. McFarlin's question more directly; under present conditions, where the physical details cannot be controlled, I think the chemical results are of great importance, much more so than if you could control the physical features. The very good rails that have been referred to had no chemical properties that would bear scrutiny at all. When they were made the laboratory did not give the minute determinations which we are able to get at the present day; manufacturers did not know and could not get them. I venture to say that those rails that you had which gave such satisfactory service had from three-tenths

carbon up to seven-tenths carbon, and the phosphorus would run from .04 to one-tenth per cent, and the manganese almost anything, but generally quite low. So if we could get steel treated physically in the way it ought to be, the chemistry would lose its great importance. As long as we cannot do that, then the important thing is to control the chemical composition of the steel. It will never give as satisfactory results, but you have those two horns of the dilemma to consider.

Mr. D. D. Carothers, Engineer Maintenance-of-Way Baltimore & Ohio Southwestern:—I would like to ask if they use nickel steel rails to any extent in the East?

Mr. W. C. Cushing, Engineer Maintenance-of-Way Pennsylvania Lines West:—A limited quantity of nickel steel rail has been used on the Cleveland & Pittsburg Division of the Pennsylvania Lines, west of Pittsburg, on a five-degree curve, but the length of time in service is too short to give results at the present time. It is certainly lasting a great deal better than the other rail, and only time can prove its superiority over the common rail. There is hardly any appreciable wear at all in two years' service.

Mr. S. P. Hutchinson, Assistant General Agent Pennsylvania Railroad:—The rail Mr. Cushing speaks of has been in service on the Pennsylvania Railroad system longer than any other rail that they have of that kind. I believe there is a little on the Horse Shoe Curve that has been in a very short time. I do not think they have gathered experience so far.

The President:—I would like to ask if any member has had any experience—if not, Captain Hunt can tell us—in the use of high carbon rails for frogs and switches.

Mr. Hunt:—Yes; there have been quite a number, quite a tonnage. I think they have given very satisfactory results; so I have been told by the engineers who have used them and with whose practice I am acquainted.

I think certainly that is the place to put harder steel. Taking second-quality rails and cutting them up to make frogs and switches does not seem good judgment—that a piece of steel that has not worked satisfactorily should be required to do the hardest duty that can be required of steel rails. I certainly should not take it. The rail was defective, either because the ingot had mechanical defects, or the chemical composition was wrong, or because the steel was overheated. It does not seem quite logical to choose weak sisters to perform big brothers' work.

In regard to chemical composition, I think a very few years is going to see a radical change in the manufacture of steel. As you probably are aware, the Tennessee Coal & Iron Company are putting in a rail mill to make rails from basic steel metal, and if the Talbot process, which is now said to be in successful operation, is all that is claimed for it by Mr. Percival Roberts and Mr. Talbot, I think the day will come quickly when the Bessemer converter will to a great extent be relegated to the background. This seems almost impossible, but when we consider what a very large percentage of the available ores are non-Bessemer, through their high percentage of phosphorus, and know the evolutions which have taken place, and have led to developments by which man has been enabled to take advantage of that which nature has provided, it does not seem so strange. By the Talbot process you can get a continuous flow of steel, just as you do from the Bessemer converter. This is necessary for the economical operation of the rail mill.

Now, if this comes about, as I believe it will, it will take away the phosphorus nightmare, and you will get your steel so that the carbon may be well up toward 1 per cent, and still have a safe rail.

Mr Peterson:—Will that make a good rail without a great deal of work?

Mr. Hunt:—I think you will never get away from the advantage of the work itself on the steel in the rail.

Mr. McFarlin:—What is the highest carbon in the Bessemer roll now that you find?

Mr. Hunt:—You know the manufacturer's standard—that is, the specifications of the Western Rail Makers. They have agreed on common specifications—some of their details are different from those used during the last few years. This does not affect all of the Eastern railroads, as they can obtain rails made according to what are commercially known as the "New York Central Specifications." Under them they can obtain steel high in carbon and low in phosphorus. The Western Specifications in 80-pound rails give carbon .43 to .53, phosphorus not over .10. The New York Central for the same weight, carbon .55 to .60; phosphorus not over .06. In Eastern practice the carbon frequently goes to .63.

We must not lose sight of safety, and therefore the drop

test should not be eliminated. We must not get rails so hard that they will be unsafe for traffic, but my experience is, and I believe it will agree with that of those who are in actual contact with maintenance-of-way, that there is scarcely ever a broken rail whose failure is not accounted for by a physical defect. Once in a while you get a mysterious break, but as a rule there is disclosed an interior pipe in the ingot, or a flaw or crack which started some time before the break. I think such cracks often come from injury done to the metal under the straightening press, where the rail was not handled correctly.

The workman is paid by the ton—but a few cents—still his aggregate is good, as he is paid on total product—so it is only human that if he can get his work accepted, as it leaves his straightening press, his individuality ceases and he is content. The rail is soon loaded on the car and gone. It may ultimately break from the unduly hard blows to which he subjected it, but his agency will be unknown.

Mr. M. H. Rogers, Chief Engineer Denver & Rio Grande:—This Association can bring to bear upon the manufacturers an influence that will induce them to make rails according to specifications prepared by those who use the rails. I think that we can, through our general managers and presidents, render our exertions along this line effectual, and that we should do so. It will increase the efficiency and life of our rails, and our Association can in that way accomplish a great deal of good. Our President has also referred to a point that, to my mind, does not, as a general thing, have the thought and care given to it that it should have. That is, it is not always the best article—not always the highest-priced article—that is really the most economical. I think we should at all times bear in mind that the best and most economical article—whether it be rails or ties, or whatever else you please—is that which gives the most wear for the least money, provided that we do not disregard the question of safety. Safety must be pre-eminent and should have the most weight in all cases. It is possible that one specification for rails would not fit the mills of the entire country, but there would have to be one specification for the use of the mills east of the Alleghanies, and one for the use of the mills west of the Alleghanies. But I have no doubt that the Committee will carefully consider that question.

The President:—There are other points in this rail matter. After we get our rail, we have got to transport it, unload it, put it in the track, repair it, take it out again, and do all sorts of things with it.

Mr. Dauchy, Chief Engineer Chicago, Rock Island & Pacific:—I think the economical length of rail should be considered along with the other matters.

Mr. Carothers:—Mr. President, I observe in the report of the Committee that they have taken up a matter of vital importance, as I consider it, in handling the rail after it has been received on the road—that is the question of spacing. With the heavy, concentrated loads that are now passing over all lines of railroad, it is of great importance that the ends of the rails should be as close together as practicable. I see they have touched upon that and they are not in a position, I presume, to recommend any special spacing. With our company, we have been using thirty-three-foot rails, and in warm weather, where our track was full ballasted, we have practically laid them with close joints. Of course, if the ballast is scarce, it is a dangerous way, because the heat will expand the rails so as to throw the track out of line, but this will not occur if the track is full ballasted. That is an important point, I believe, to be considered.

The President:—On the Illinois Central Railroad our practice for some years back has been to lay our rails at one-half of the old theoretical expansion. On recent work we have followed the same practice that Mr. Carothers has in warm weather. The old idea used to be that the expansive power of metal was something that could not be controlled. We now find it simply a question whether the track is so constructed and the rails so controlled that you can retain the expansion in the metal itself. If I am not correct in that, there are a great many members here who are competent to correct me, but that is the theory we are working on in reducing the amount of our expansion, for the reason that the wear and tear of our joint is largely because of the opening, and the closer we can keep the rail together the better and the more economically we can preserve it. The possibility of doing that was brought forcibly to my mind because of the fact that for years I have noticed that, no matter how carefully you might lay the rail over a hilly country, you will find sometimes, for one or two or three miles, in a sag, there will be no

expansion whatever. We are able to retain that expansion in the rails themselves, and we have been doing that for years, while at the top of the hill, at the end of the grade, the expansion will be excessive, and we have to close our rails up in order to reduce the expansion.

Mr. McNab, Assistant Engineer Grand Trunk:—Mr. President, if I understand rightly, a few years ago the Michigan Central Company laid some portions of its road with certain lengths of continuous joints, and for information I would like to know if it was an experiment, what the general result was; the Chief Engineer will no doubt be able to give some particulars.

Mr. A. Torrey, Chief Engineer Michigan Central:—In 1893 I brought a lot of rails together, individual rails. As I remember it, on one side I had a built-up rail 800 feet long, and on each end of that 800-foot rail I left a rail 100 feet. On the other side I had one built-up rail 500 feet long and on the other side, in juxtaposition to that, two rails, at each end of that, 250 feet long. Those rails are in that same condition now, with this exception, that in the 800-foot rails the expansion increased a little too much and we cut that down to 500 feet and made the expansion joints about opposite each other. I found that the expansion was quite a feature in that, and that if the tie was jammed to the spike it moved right along without kinking out the rail. It wouldn't seem to affect the expansion that would occur between the morning and noon of a hot day. I used the data I got from daily observation of that rail to get up expansion allowances for the road, which I use now. I have the foreman determine what the temperature of the rail is by leaving his thermometer in the gravel alongside; but first I gave it by instruction, and the way the foreman did that was to keep the thermometer in his pocket. The result of it was that one summer, in 1896, I compared the size of the shim I used, determining it by the exposed thermometer instead of by a shaded thermometer. I found there was 25 or 30 per cent less expansion than I had been previously allowing. My aim was to have the rails touch without particular pressure at 120 degrees in the sun, and have the expansion go by the rail. The largest shim I used was 3-16 inch. The trouble I found, and of course everybody has, was that, although I would lay it that way, I couldn't keep it up. In some places where the track ran together I cut out pieces of rail from time to time. I don't think,

in the manner the President was speaking of, you can lay more than 10 or 20 rails together on a hot day without taking some out. For a year I took observations of the behavior of that rail daily, one at 7 o'clock in the morning and one at noon, and I found there was no movement in the rail from the time that the thermometer got down to 20 degrees Fahrenheit until it got to 20 below zero, during a stretch of temperature that varied 40 degrees. The earth didn't move at all. I don't know why. I can't suggest why it didn't, but it did not. But it was very sensitive to temperature that ranged between 20 degrees above zero Fahrenheit and 125 degrees. I think that is the highest ever recorded. The temperature was ascertained from a thermometer embedded in a piece of rail alongside of a rail; this was covered with a metal slide. The temperature was observed daily and a record of the amount of expansion made. The joints of that rail were pretty near as good as when put in.

The President:—Have the members any further remarks to make? Of course, we realize that we don't expect to exhaust the subject at this meeting or the next or in our lifetime, but we are simply laying the foundation now for our future work, and I presume at the next meeting the Committee will not be still "fuller" than they are now, but that there will be more of them present, and that they will continue the consideration of this matter.

I will, therefore, excuse them and call the next, Uniform Rules, Organization, etc.

Gentlemen, I take pleasure in introducing Mr. Carothers, Chief Engineer of the Baltimore & Ohio Southwestern Railroad, as chairman of this Committee.

REPORT OF COMMITTEE XII.—ON UNIFORM RULES, ORGANIZATION, TITLES, CODE, ETC.

To the American Railway Engineering and Maintenance-of-Way Association:

The work before this Association is so great that no member should shirk the responsibility that membership in the Association implies. Each member has a duty to perform, and the more vigorously it is done, the better the result for both the Association and individual members.

The railroads of the whole country are sure to derive great benefit from the work of the committees, if the work is carefully done, even before final action is taken by the Association. The appointment of the

Committee was so recent that it has precluded any meeting or work before this meeting of the Association. It was my desire to have at least one meeting of the Committee over which I have the honor to preside, so that I could express at this time their ideas as well as my own.

The Board of Direction has requested me, as chairman of the Committee—"No. XII, Uniform Rules, Organization, Titles, Code, Etc."—to prepare a short paper outlining the work of this Committee for future consideration.

I hardly know what can be said in a short paper which will enlighten the Committee or the Association, for the field is so large and the interests so varied that it will require much time and careful consideration to formulate, even in the most general way, an organization or rules which can be applied to all railroads in this country. That the Committee may be enlightened as to the views of the members representing many railroads in all parts of the country, I hope that each one will give us his views by a full discussion of this subject, so that our work may be done on lines that will meet the approval of the Association at the next meeting, when our report is presented. Each member of the Committee is expected to render all the assistance he can in preparing this report.

The Committee should meet at least twice before the next Association meeting, at the headquarters of the Association, or such other place as may be convenient. I favor headquarters for the reason that we can have the Secretary, and all papers of the Association for reference. The work of the Committee should be conducted on the lines of the committee-work of the American Railway Association, and it will be necessary to consider carefully the actions of that Association in our work, so that our recommendations will not conflict with the very valuable work of that organization.

The proper organization of a "Maintenance-of-Way Department" is the first subject given to us.

The second subject is "Code of Titles," applicable uniformly over the entire country.

The two subjects can be considered together, quite as well as separately.

Proper organization is absolutely necessary for efficient service wherever human agents are employed, and this is especially emphasized in the maintenance-of-way department, as the work of that department is scattered over the entire road, and there are so many different kinds of work, each kind requiring a skilled man in charge, and all having ready access to the head of the department, that it will, I am sure, require no argument here to convince this Association of the necessity for a proper organization. There are many things to consider in undertaking to establish a uniform organization that can be applied to all railroads represented in this Association.

1. First, and probably the hardest to overcome, is prejudice in favor of each railroad's present system, for it is evident that their present system has been established after careful consideration, and each man in charge, introducing the system, always feels that it is the best adapted to his line.

2. Economy of operation on some railroads will compel them to do with a much less expensive organization than others. This, however, can be overcome much easier than the first.

3. The difficulty of adapting an organization to railroads of unequal length and importance.

4. On some railroads the organization is provided for in the by-laws and it would be much trouble to change them.

CODE OF TITLES.—I believe a general organization, with uniform titles, can be arranged that will in time be adopted by all the railroads of this country; at least, it is the duty of the Committee and of the Association to recommend what they consider the best, and leave the rest to the railroad companies.

Titles are not so essential, although proper titles play an important part in organization of the department, and should be considered with that subject. The title of an officer should, so far as possible, indicate the position he occupies with the railroad company, and the service he is expected to perform.

Trusting that the Association will be liberal with criticisms, I submit the following rough outline of a "Proper Organization of a Maintenance-of-Way Department," not with the authority of the Committee, but merely to get the views of the Association, to assist in getting our work started.

CHIEF ENGINEER.—The Chief Engineer should be the active head of the department, and he should be so fortified with assistants that he will have ample time to investigate all important subjects pertaining to the department; visit other railroads in this, as well as in other countries, so that he can adopt for his company the very best methods practiced on the best railroads in the world.

PRINCIPAL ASSISTANT ENGINEER.—The Principal Assistant Chief Engineer will report to and represent the Chief Engineer, and perform such other duties as may be assigned to him.

BRIDGE ENGINEER.—The Bridge Engineer will report to the Principal Assistant or Chief Engineer, and will have charge of the designing of all bridges, trestles, culverts, etc. He should inspect all important structures as frequently as possible, to see that they are properly maintained.

SIGNAL ENGINEER.—The Signal Engineer will report to the Principal Assistant Engineer or Chief Engineer, and will have charge of the designing and installing of all interlocking plants, automatic block signals, highway-crossing alarm bells, and all other special signal work.

ARCHITECT.—An architect should have a place in the organization and should report to the Principal Assistant or Chief Engineer. He will design and superintend the erection of all important buildings.

REAL ESTATE AND TAX AGENT.—The Real Estate and Tax Agent will report to the Principal Assistant or Chief Engineer, and will have charge of all real estate and right-of-way of the company, and see that the property is properly returned for taxation.

SUPERINTENDENT OF TELEGRAPH.—The Superintendent of Telegraph will have charge of the construction and maintenance of all telegraph

and telephone lines, reporting to the Principal Assistant or Chief Engineer on all matters pertaining to said construction or maintenance.

ENGINEER MAINTENANCE-OF-WAY.—The Engineer Maintenance-of-Way is really the working head of the department. He will, in a large measure, be the real head, as he will have charge of all classes of maintenance work, reporting to the Chief Engineer.

These seven can be considered the staff of the Chief Engineer, and this staff may be enlarged by such officers, as electrical engineer, etc., and all the above to be supplemented by Assistant Engineers, draftsmen, inspectors, clerks, etc., as circumstances may demand. Roads of short mileage or light traffic may dispense with part or all of the above officers, except the Chief Engineer, who may be able to perform all of the duties outlined above.

The organization from this point to the most subordinate position can be applied the same for all railroads, whether large or small.

DIVISION SUPERINTENDENT.—The Division Superintendent should be the general manager of his district. I mean by this that he should be in full charge of all departments. In maintenance-of-way matters he should report to the Engineer Maintenance-of-Way, or the Chief Engineer, as the case may be.

DIVISION ENGINEER.—The Division Engineer should be the Engineer Maintenance-of-Way for his division, in charge of all maintenance-of-way work, and report to the Division Superintendent.

ASSISTANT DIVISION ENGINEER.—Each division should have at least one competent Assistant Engineer. He should be a man of practical experience, able to look after all the work during the absence of the Division Engineer, superintend the erection of any structure, make surveys, and do any work the Division Engineer or Division Superintendent may require.

TRACK SUPERVISOR.—The Track Supervisor will report to the Division Engineer and should have charge of such number of miles of road so that he can give his personal supervision to all important work on the part of the road of which he has charge. Each part of the road so divided should be numbered and known as a district.

TRACK OR SECTION FOREMAN.—The track or section foreman will report to the Track Supervisor, and the track of which he has charge will be numbered and known as a section. He should have charge of only so much of the road as he can keep in proper repair. This will be governed by the number of tracks and the traffic over them.

EXTRA GANG FOREMAN.—The extra gang foreman will do such important work on the district as may be assigned him by the Supervisor.

WATER SUPPLY FOREMAN.—This foreman will report direct to the Division Engineer, and will have charge of all water stations within certain defined limits, keep up repairs, see that all stations are supplied with fuel, that the pumpers are on duty and water is always ready for the locomotive when it arrives at the water crane.

FOREMAN OF STRUCTURES.—There should be at least one gang of skilled carpenters, with a competent foreman in charge, on each division,

to keep in proper repair all buildings. He will report to the Division Engineer.

At least one bridge foreman, with a gang of carpenters and laborers, should be located on each division, to keep in repair all bridges and trestles. He will report to the Division Engineer.

At least one foreman of masonry, with a gang of masons and helpers, should be located on each division, to keep in repair all masonry. He will report to the Division Engineer.

SUPERVISOR OF SIGNALS.—The Division Engineer should also have a Supervisor of Signals, who should look after the repairs of all signals on his division.

In the foregoing rough outline I have indicated in some instances some of the duties of the position. This does not belong to the organization, as I view it, but to the rules and regulations. As I understand the work of the Committee, it will be very difficult to consider the subdivisions separately. Before any rules can be formulated intelligently we must establish our organization, so that we may know to whom the rules apply.

The Committee should carefully examine all books of rules now in use governing maintenance-of-way departments, also the code of the American Railway Association, and then try and formulate only general rules that can be adopted by all railroads. To do this it will be necessary to follow the present general practice, so far as possible. After the rules have been adopted on a few of the larger systems, changes can be made as circumstances demand, the same as train rules are constantly being changed by the American Railway Association.

CODE OF MAINTENANCE-OF-WAY ETHICS.—After our organization has been completed, and our rules adopted, the code of ethics of the maintenance-of-way department, as applied to each railroad, will be pretty well established. I think the relations existing between the different maintenance-of-way officers is quite well understood at present, and I do not care to introduce that phase of the subject until we have gotten through with some of the other more important work.

We hope the Association will be kind enough to us to enter into a full discussion of all the work laid out for our Committee.

D. D. CAROTHERS, Engineer Maintenance-of-Way Baltimore & Ohio Southwestern, Cincinnati, Chairman;
W. J. WILGUS, Chief Engineer New York Central & Hudson River Railroad, New York, Vice-Chairman;
E. H. FITZHUGH, General Manager Central Vermont, St. Albans, Vt.;
G. A. QUINLAN, Vice-President and General Manager Houston & Texas Central, Houston, Texas;
JAMES ODORNE, General Superintendent Canadian Pacific, Winnipeg, Man.;
T. F. WHITTELSEY, General Superintendent Toledo & Ohio Central, Toledo, Ohio;
C. S. CHURCHILL, Engineer Maintenance-of-Way Norfolk & Western, Roanoke, Va.;

J. T. MAHL, Engineer Maintenance-of-Way Southern Pacific, Houston, Texas;
F. B. HARRIMAN, Superintendent Illinois Central, Dubuque, Iowa;
Committee.

Mr. Carothers:—Mr. President, I want, before entering into the discussion, to make a few explanations. We have had no meeting of our Committee, and I find that the members present take exceptions to some things that the Chairman has proposed. The organization set forth in this report or paper emanates entirely from myself, and the other members are not in any way responsible for it. I believe they do not care to follow out the idea of it. However, so that we may provoke some discussion, I present it. It is a very hard matter for the Committee to formulate an organization that will apply to all railroads of this country, and we would be very much obliged if the members would throw some light upon this subject, so that we will be prepared to act intelligently in accordance with their views. We can't go ahead with the rules governing the organization very well until we have decided at least some of the essential features of the organization.

The President:—Well, I don't know if this report is a majority or minority report. I suppose that we will have to poll a jury in this case. Mr. Whittelsey, what have you got to say about the matter?

Mr. T. F. Whittelsey, General Superintendent Toledo & Ohio Central:—Mr. Chairman and gentlemen, I am perfectly satisfied with the report if it is merely for the purpose of discussion. The plan outlined by our chairman is not one that meets with my personal approval or that I would approve for the adoption by the Association.

The President:—Mr. Churchill, have you anything to say?

Mr. C. S. Churchill, Engineer Maintenance-of-Way Norfolk & Western:—I concur generally in what Mr. Whittelsey states. I recognize the fact that there are railroads which have organizations varying very considerably from that outlined in this report, and organizations such as we could not change. I think, therefore, that it is not quite within our province to go into the details too much. The amount of detail for us to go into had best be determined by the Association as a body, giving us instructions as to how much and how far we shall go into the business of the organization of the maintenance-of-way depart-

ment of railroads. There are thousands of miles of road represented here which have an organization entirely different from this, and I would not undertake to say which is the best, nor could I undertake to say that any one of them had bad features in them, because I think we are not in a position to decide on the good and bad features in an association meeting like this; nevertheless, there is much to be said in favor of discussion. I concur in what Mr. Whittelsey has said, that at the present time the more general lines should be taken up and others later on.

Mr. James Oborne, General Superintendent Canadian Pacific:—I drafted a letter to the chairman along the lines adopted in the presentation of the report, namely, that the character of the different roads in the various sections of the country will largely govern the organization of the maintenance-of-way department. I have not had sufficient opportunity to get through with this report and study its recommendations to be able to speak intelligently upon it, but, judging from its length, it is quite evident that the chairman has provided sufficient food for discussion.

The President:—The essence of this matter is that the chairman of the Committee considers it necessary to settle the question, or at least to determine the subject of organization, as a basis of the consideration of the question of uniform rules, and that he has suggested, not a standard organization, but a typical organization, and that about one-half of the Committee did not agree with him. The question is simply this: First, as to the proper way of carrying on the work of this Committee—whether they should make any suggestions at all in reference to organization at present, or whether they should investigate and endeavor to set forth different forms of organization, so that eventually the Association can adopt the best type of organization. The matter is now open for general discussion.

Mr. Carothers:—Before going further—if you will pardon me for a word more—my idea of this organization is that it should be a similar organization to what is known as the American Railway Association. The American Railway Association deals with subjects pertaining to transportation largely, almost exclusively. The officers and employes in that department are well understood and defined all over the country. A code of rules has been established by that association that is almost uniformly

adopted—either in whole or in part—on all the railroads, and those rules apply to individuals employed on the different railroads and their titles. It does seem to me that it is necessary to establish the positions that men occupy in the maintenance-of-way department before we can form intelligent rules governing their positions. That is the reason I have outlined this organization merely for discussion.

Mr. C. A. Wilson, Chief Engineer Cincinnati, Hamilton & Dayton:—The American Railway Association is an association of railways represented by men who can put in force whatever they wish. They have studied the questions that they pass upon. If we had in this Association, what we hope to have, and what we invited into it—all the general managers of the railways—then we could take up, I think, a good part of what Mr. Carothers has set out, but until we accomplish something of that kind it seems to me, if the Committee would devote itself to those things upon which we could pass and to which we could subscribe, the Committee would have as much as it could get through with at the start. The particular subject, it seems to me, they can do the most work on is the third subject, "Rules and Regulations for the Employes of the Maintenance-of-Way Department." The American Railway Association has not gone much further with that sort of thing than is set forth in the Standard Train Rules, which simply set forth the duties of trainmen and those employes immediately connected with them in operating or moving trains, and what should govern them. I don't believe they have even got so far as to set out the duties of other employes in the transportation department. They certainly haven't got so far as to state what the duties of the officers are, or what the titles are. It seems to me we can commence on a very small part of this subject and do a great deal of work before we try to get around to the organization of a railway.

Mr. Curtis, Engineer Maintenance-of-Way Southern Pacific:—I have had some experience in making rules for various organizations. The Southern Pacific Company's rules for the maintenance-of-way department are used on five different properties, aggregating ten thousand miles. The important part of these rules is made for roadmasters, foremen of bridges and buildings, and foremen of track and section masters. The rules are made without reference by title to other officers. They say,

"Head of Maintenance-of-Way Department." That fits anybody who acts as the head of the maintenance-of-way department. We define what is meant by roadmaster and define what is meant by superintendent or general foreman of bridges and buildings. We have managed in our rules to make them apply to three and four different kinds of organization. The important rules are directed to the foremen—the men who are actually doing the work—and it seems to me that the Committee might try working somewhat on those lines. It doesn't matter so much what you call the officer whose duty it is to supervise the work.

Mr. Wendt, Assistant Engineer Pittsburg & Lake Erie:—Mr. President, I wish to ask the chairman two questions: The report says that the Division Superintendent should practically be the local general manager of his division, and that in all maintenance-of-way matters he should report to the Chief Engineer. The Division Engineer would report to the Division Superintendent. The question arises: Does the Committee think it necessary that a Division Superintendent should be an engineer? If he is not an engineer, should he be held responsible for the maintenance of track, bridges and buildings?

What are the advantages and disadvantages of the organization in effect on the Lake Shore & Michigan Southern Railway, where all maintenance matters come directly under the Chief Engineer or his assistants?

Mr. Carothers:—Mr. Chairman, of course, the Committee did not approve this report. This is an individual report, and, as I explained in the beginning, we desire information, and we prefer that somebody who has had experience with both kinds of organizations enlighten us on this subject. That is what we are here for—to be enlightened as to what the views of this Association are. The Superintendent on many railroads is chosen from the maintenance-of-way department. In many cases he is chosen from the transportation department, and is still in charge of the maintenance, so far as the division is concerned. I don't see but that it works very well in both instances. We have both kinds on our railroad, and get along very nicely. In one instance we have an engineer, and in others have a superintendent.

Mr. H. D. Miles, Signal Engineer Michigan Central:—I think the Association can do valuable work in the matter of the organization of the maintenance-of-way department. It is, how-

ever, a question that will have to be considered at some length and a great deal of preliminary work will have to be done before any actual organization can be mapped out. The conditions on the several railroads vary to such an extent as to make it difficult to form a standard organization, and may perhaps prevent a standard form of organization. I notice that the Committee has recommended a certain form of organization for the signal department. My opinion varies from that of the Committee in regard to this organization, but as I understand that the general trend of opinion is that nothing definite will be done for some time, it is scarcely necessary for me to state my views now. I think, however, that some action should be taken by the Association in regard to rules governing the employes of the maintenance-of-way department, especially those relating to rules governing the maintenance of interlocking plants. There are a great many different kinds of rules governing the employes in charge of the maintenance of such plants, and it frequently occurs that two or more different sets of rules are placed in an interlocking tower to govern the foreman who maintains the plant. It is, therefore, advisable to have a standard set of rules for the guidance of men performing such work, and such rules could be jointly issued by all of the roads interested in any particular interlocking plant. Another point suggests itself in connection with the matter of rules for the guidance of men in charge of maintenance-of-way matters, and that is as to what committee or committees is to have charge of such work. Is this work to be performed by the special committee on Rules and Organization, or will the rules governing the maintenance of the different branches of maintenance-of-way matters come under the various committees in charge of the several special subjects?

The President:—Mr. Miles, it would seem to me that the most practical way to handle that would be, for instance, in this case, for the Committee on Interlocking to formulate the rules that are applicable to this particular work, and then to submit those rules, with reasons for them, to the chairman of the Rules Committee, so that when we get far enough along to publish general rules, they should be embodied in the report of that Committee, but it would seem that the part relating to interlocking rules, which are technical and applicable to that particular class of work, should originate with that Committee. That was the

idea that the Board of Direction had when they made this general outline of committee-work.

Mr. Miles:—That was left out—it was not mentioned in the work assigned to the Committee, and I merely wanted to know how that was to be arranged.

The President:—That was the opinion of the Board at the time the matter was discussed—that it would be handled in that way. I notice there is no particular mention made of interlocking rules under the head of Uniform Rules, Organization, Titles, etc.

This is a very broad question, gentlemen, and there is a great deal of difference of opinion in regard to the proper organization of the maintenance-of-way department, and its relation to other departments, and it is a matter, of course, that we will not be able to settle for probably a good many years to come, but for my part I cannot see why the Committee should not take that feature up in connection with their other work and give us their ideas from time to time. I think the first work of the Committee should be to find out what the present practice is; that is, how many roads use a certain form of organization, and how many roads use a certain other kind of organization, and confine their work to general organization at least, first making a statement to us what the roads are now doing, toward what form of organization they are tending, and later on, after we have discussed it thoroughly, and commenced to make recommendations as to organization — I agree with Mr. Curtis — that there is no reason why the Committee should not take up the track rules—that is, the actual working rules—regardless of the higher form of the maintenance and reorganization.

Mr. Carothers:—Mr. Chairman, the Committee being appointed at a late date, it was impossible to obtain and consider the rules of the maintenance-of-way department of roads all over the country, which is absolutely necessary before we can present anything to the Association that could be adopted. It would not be well for this Committee to introduce an entire new system, or very many new things; it should make it as composite as far as possible to be applicable to the present organization, or as nearly as possible, and develop it in the future, and with that object in view we have secured the rules of the different railroads, or a great many of them at least, but we

have had no opportunity to meet and discuss them. Therefore, it was impossible at this time to present a report regarding the rules at all. It was a very difficult subject.

The President:—We are not criticising the chairman of the Committee. Of course, we have obtained a great deal more out of these committees than we had any idea we would get out of them, owing to the short time in which they have had to prepare the subjects, and one gratifying feature of our work is that we haven't had to spur up anybody. This Committee seems to think that we should check up its chairman—this we will leave for the Committee to do.

Mr. Whittelsey:—Mr. Chairman, I think it the province of this Committee to hold a meeting to get acquainted and get to work. I then think it should classify the organization, titles and rules of the maintenance-of-way department of all the railways of the country, tabulate the information, and then we will be able to proceed to some definite object. And I would like to suggest that inasmuch as this paper by Mr. Carothers does not represent the views of the Committee, that that portion of it describing the officers and their duties be eliminated from the proceedings of the convention.

The President:—When these Proceedings are published, this discussion will be made a part of it, and it would seem to me that the opportunity that the individual members of the Committee have had to express their personal views would be enough to counteract the report, so that none of you will be misrepresented. It might be a fact that other members of the Committee may accord thoroughly with Mr. Carothers' views, and by publishing the report as he has given it, his statement that it is his individual report, and the statement from the other members of the Committee who are present giving their personal views, I think will keep that matter straight.

Mr. Wilson:—Mr. Chairman, I would like to say a word about what Mr. Whittelsey says. I noticed that our Honorable President and the other officers have been trying to get the indorsement of the higher officers of the railways in the Association, and it doesn't seem to me that we want to publish this sort of thing, that will go to some of those gentlemen, who, I know, have very decided ideas about what a railway organization ought to be, and will say: "Well, they are commencing

to do that sort of work; the boss will have to drive the wagon; we won't waste much time with it." That is what I want to say, as to trying to tell the boss how to do his work.

The President:—I don't think we ought to cut it out. I think we ought to invite the boss to get in the wagon and drive with us.

Mr. Oborne:—I would like to add this: We must not have too much regard for the boss. The boss employs men for the maintenance-of-way for their technical knowledge, and if they have anything to say as to the proper organization of the maintenance-of-way department, I think it is their duty to make that suggestion. As to whether it shall be accepted or not is a matter that remains with the boss.

The President:—The boss will have more influence over this convention by coming in here and telling us what he wants us to do and helping to pay for it.

Mr. Tratman:—I suggest, in view of this difficulty, that we add the words "as outlined by Mr. Carothers." Then it would follow as a personal paper from him, embodied in the reports.

The President:—With the qualifying statement that has been made, in the absence of the other members, I don't think we ought to make any change in the report. I think we ought to let it go as it is. Let Mr. Carothers fight it out with the Committee. This has been a very interesting matter, but we have others to follow. We will excuse this Committee and let them get together in their ideas.

We will now have the Committee on Track. This report will have to be read. Mr. Handy turned the matter over to Mr. Baldwin, the vice-chairman, and Mr. Baldwin could not give it attention. We have Mr. Moll, Mr. Robinson, and Mr. Landon, members of the Committee, and Mr. Landon will read the subject-matter which he has in his possession. We will, therefore, have to excuse the Committee from an elaborate report.

Mr. H. C. Landon, Chief Engineer Buffalo & Susquehanna:—Mr. Chairman, I fully expected Mr. Baldwin to be here yesterday, and the rest of the Committee evidently did

so as well, and I expected to be here myself, but missed connections on account of the weather in our country. This morning I received a communication from Mr. Baldwin stating that he would not be here, and he left me certain papers, which contained a scheme of report from Mr. Moll, and we will read that as our report, as we are unable to do anything further, and it covers the ground.

REPORT OF COMMITTEE V.—ON TRACK.

To the American Railway Engineering and Maintenance-of-Way Association:

1. Maintenance of line:

The rails on tangents should be brought to true, straight line, special care being taken to remove short kinks; and on curves they should be truly lined to centers, the ends of the curves being eased by spirals to extend each way from the original point of curve as far as may be permitted by the width of the roadbed.

The center line of long tangents and of curves should be established by careful instrument work, and all work on track should be done in reference to such line.

To secure permanency of center line, either monuments or reference points should be established at the points of curves, and at intermediate points on long tangents.

2. Maintenance of surface:

The elevation of curves should be governed primarily by the speed of trains passing over them; but as the speed varies greatly with the same train at different places, and still more with different classes of trains, it necessarily follows that no rule can be laid down for the elevation of any degree of curve at all localities, but each case must be judged by itself, and subject to such considerations as the judgment of the Roadmaster may dictate.

As the comfort of the traveling public is rather to be sought for in this matter than other considerations, the subject of passenger trains is generally taken to govern the amount of elevation to be given to curves. This amount is given in well-known standard tables of elevation of outer rail of curves.

When curves are spiraled, the elevation should, theoretically, begin at the beginning of the spiral, and reach its maximum where the spiral ends and the true curve begins; but this is generally too short a distance, and makes the rise too abrupt. The following rule we find a good one:

The elevation to be at the rate of one inch per fifty feet on the tangent approaching the curve, and to reach the full amount of elevation at the beginning of curve.

Some claim that curves ride better by using two-thirds of the elevation on the tangent, and running out the remaining one-third to full elevation on the curve. When there is not more than one hundred feet of tangent between two curves in the same direction, the elevation should be carried without reduction from one curve to the other, but if the distance is more than one hundred feet, the elevation of each curve should be eased off to whatever it may be at a point midway between them.

All abrupt changes of grade should be eased by vertical curves. This is especially important at the foot of steep grades and when a level grade changes abruptly to a descending grade.

3. Maintenance of gauge:

In gauging track, the gauge should be placed squarely across the track; the rail held tight to the gauge; the outside spike started first; both spikes driven at the same time, and the gauge not removed until both spikes are driven home.

The inside spikes of both rails should be to the same side of the center line of the tie, and the outside spikes to the opposite side. This helps to prevent the slewing of the ties.

All curves of six degrees and under should be of true standard gauge. The gauge of curves of over six degrees may be widened at the rate of one-eighth inch per degree up to three-fourths of an inch, or to a gauge of 4 feet 9¼ inches, which should be the limit.

The spreading of track and canting of rails is best prevented by the use of tie-plates.

4. Inspection of track:

Where track is liable to be obstructed at certain seasons by washouts, landslides, falling rocks, etc., track-walkers should be stationed to patrol the track and give warning to trains. Whenever, for any reason, the regular track crew cannot run over the section, one of their number must be detailed to patrol the whole section, in one direction at least. It must be the first duty of sectionmen, in starting out for the day's work, to examine carefully all switches, frogs, crossings, derailing points, interlocking plants, etc., and see that the same are in sound condition and in good working order.

5. Tools:

Following is a list of tools furnished to the respective sections into which the track force of the Chicago, Milwaukee & St. Paul Railway Company is divided, with instructions governing the accounting for the same:

STANDARD LIST OF TOOLS AND MATERIAL

To be carried on each Section.

Class A.	Class B.	Class C.	
1	1	1	Adze, Handled.
1	1	1	Ax, Chopping, Handled.
1	1	1	Ax, Hand, Handled—2 where needed for shimmi
8	8	6	Angle Bars.
100 lb.	100 lb.	50 lb.	Bolts, Track.
1	1	1	Brace and Bit, ⅝-inch, where needed.

Class A.	Class B.	Class C.	
1	1	1	Brooms.
3	2	2	Bars, Claw.
5	4	3	Bars, Lining.
6	4	4	Bars, Tamping.
1	.....	.....	Bars, Raising.
1	1	1	Cars, Hand.
1	1	1	Cars, Push.
6	6	4	Chisels, Track.
6	4	3	Cutters, Weed, where needed.
2	2	2	Cans, Oil, 1 gallon.
2	2	2	Dump Boxes for Push Car.
1	1	1	File, Flat, 12-inch.
1	1	1	File, Three cornered, 6-inch.
.....	.....	.....	Forks, Manure, where needed.
2	2	2	Flags, Red.
2	2	2	Flags, Green.
1	1	1	Grindstone and fixtures.
1	1	1	Gauge, Track.
1	1	1	Grass Line, 200 feet.
1	1	1	Hammers, Nail.
3	2	2	Hammers Spike. Handled.
2	2	1	Handles, Spike Hammer, extra.
2	2	1	Handles, Pick, extra.
1	1	1	Handles, Adze, extra.
1	1	1	Hand Rake (iron), where needed.
1	1	1	Hand Car Oiler.
2	2	2	Lanterns, White.
2	2	2	Lanterns, Red.
2	2	2	Lanterns, Green.
5 lb.	5 lb.	5 lb.	Nails.
100	100	100	Nutlocks and Washers.
4	3	2	Picks, Dirt, Handled.
6	.....	.....	Picks, Tamping, for stone ballast.
1	1	1	Rail Punch.
8	6	4	Shovels, Track, one for each laborer and foreman, and 2 extra, Class A—1 Extra Class B and C.
4	2	2	Shovels, Scoop, where coal or cinders are handled in summer, and for all sections for snow in winter.
1	1	1	Saws, Cross-cut.
1	1	1	Saws, Hand.
1	1	1	Spike Puller.
1	1	1	Sledge, Handled, 18 lbs.
5 lb.	5 lb.	5 lb.	Staples.
6	4	3	Scythes, Grass, weed or brush, one for each man where needed.
1	1	1	Tape Line, 50 ft.
1	1	1	Track Level.
200 lb.	200 lb.	200 lb.	Track Spike.
1 box.	1 box.	1 box.	Tie Plugs.
12	12	12	Torpedoes.
1	1	1	Track Jack.
4	3	2	Wrenches, Track.
1	1	1	Wrenches, Monkey, 14 inches.
1	1	1	Wire Stretchers.
6	4	3	Whetstone (one for each scythe).
1	1	1	Water Pail and Dipper or water keg, Wheelbarrows, where needed.

TO BE CARRIED BY ROADMASTERS AND SENT BY THEM WHERE NEEDED:

3 Rail Drills.
18 Drill Bits.
2 ¾-inch Augers.
4 Track Levels.

The sections of this company (C., M. & St. P.) are to be divided into three classes (A. B and C.), for the purpose of indicating what tools are to be carried on the sections of each class. The above is a list of tools and material which each section will be permitted to carry. The classes of each division will be indicated by special notice. Section foremen must keep a strict account of all tools received, and at the end of the month, report upon the blank under proper heading, tools and material on hand the first of the month, received during the month, and on hand the last of the month, and forward the report promptly to the roadmaster on the first day of each month. Roadmasters must check and approve the report and then forward it to division superintendent.

Section foremen will not be allowed to carry more tools or material than is shown on the list.

Each month, or oftener if necessary, or less frequently if desirable, roadmasters will arrange to start a car over their divisions to pick up surplus and broken tools for shipment to the storekeeper. In making such shipments, foremen must securely tie up the tools and attach a tag which must show a list of the tools sent, and from what section and division, and by what foreman. They must fill out blank and hand to the agent at the station from which the tools are shipped, and obtain from the agent a receipt for tools so forwarded, which must be carefully preserved.

When necessary to send tools for repairs, foremen must securely attach a tag to the tools on which must be shown a list of the tools sent and from what section, division, and by what foreman. Foremen must obtain from the agent receipt for tools so forwarded.

Section foremen will be required to account for each and every tool sent them, and a broken or worn out tool will be required for each new one furnished. The new tool will be sent before the old one is returned to the storekeeper if necessary, but the account will be held against the foreman until the old tool is received by the storekeeper.

When extra or floating gangs are to be organized, requisitions for tools will be made by the roadmaster of the division where the gang is to work, who will be held responsible for the care and final return of the tools to the storekeeper.

In such cases the roadmaster will carry out the instructions prescribed for section foremen.

The handcars and pushcars which have been in general use on that road, until recently, have been of their own make, with no special features, but with large heavy cast wheels. These are excellent cars of their kind, and cannot be surpassed for large gangs of men, but are too heavy to be readily handled by small section crews, and they are gradually replacing them with light cars of standard modern make.

6. Frogs and switches:

For turn-outs from the main line, split switches and spring rail frogs should be used. For yards, rigid frogs and stub switches have generally given good satisfaction; but with the increasing weight of engines, the strains on the switchstands are becoming so great that split switches are coming more into favor in yards and on sidings.

A No. 10 frog gives an easy lead from the main line, where traffic sometimes passes at considerable speed, and this is a suitable, if not the best, angle to use.

For increasing the safety of facing point switches, cam locks should be used, which insure the point being in perfect contact with the stock rail.

7. Crossings:

The track at crossings should be prepared with special care, on account of the unavoidable pounding of trains passing over them, and drainage should be as perfect as possible.

These conditions are probably best filled by using as ballast a heavy body of crushed stone. Plate-riveted and filled crossings are the ordinary types in use. Our experience has been most satisfactory with reenforced filled and bolted crossings.

8. Guard-rails:

Guard-rails should be of the same height as the adjoining track; should be about ten feet long for rigid frogs and fifteen feet long for spring frogs. The last foot at each end should be bent outward at an abrupt angle, to give more stability, and as a means of securely fastening it to the ties. If not bolted or clamped to the track rail, the guard-rail should be braced with not less than four rail braces.

The flangeway at a point opposite the frog points should be 1⅞ inches wide, tapering gradually to three inches at the end. At the ends of guard-rails, as well as at all places about frogs and switches, where there is liability of the foot being caught, foot-guard protection should be provided. This may be done by special castiron fillings, by plank fitted into the spaces and secured by spiking to the tie or by Hart foot-guard, bolted to guard and track rail.

9. Joints and fastenings:

Notwithstanding the large number of joint fastenings of varied designs in regular use and on trial, none, so far as we are aware, have shown any great superiority over the standard angle bar; and we look for the ideal joint fastening to be a modification of the angle-bar, with a rail-base support, and in as few parts as possible, preferably only two.

10. General questions:

Policing:

As far as is consistent with the demands of trackwork proper, a certain amount of time should be devoted to the work of putting the right-of-way and station grounds in neat and orderly appearance.

Tall trees which would reach the track in their fall should be cut down and removed, if upon the right-of-way; if outside the right-of-way, they should be removed, if possible, by agreement with the owner of the land, and such agreement should be made a matter of record.

Brush and weeds must be cut and burned; grass mowed or burned; and old ties as soon as removed from track must be piled. New ties which have not been used must be neatly piled where they may be easily reached if necessary.

Track scrap, as well as links, pins, or whatever may fall from passing trains, must be picked up daily, carried to the station, and placed on a platform provided for that purpose.

Rubbish or litter of any kind must be removed from the station grounds, and lawns about them must be kept neatly trimmed and watered.

Highways and farm crossings must be kept in good repair.

Fences must be kept in good repair; ends of posts and boards sawed

off to true lines; and all broken boards, slivers and blocks which cannot be utilized must be burned.

Portable snow fences when removed from the fields in the spring must be neatly piled, and grass and weeds removed from around them, so that they may not be in danger of fire.

E. A. HANDY, Chief Engineer Lake Shore & Michigan Southern Railway, Cleveland, Ohio, Chairman;
H. F. BALDWIN, Chief Engineer Chicago & Alton, Chicago, Vice-Chairman;
S. B. FISHER, Chief Engineer Missouri, Kansas & Texas Railway, St. Louis, Mo.;
W. W. GWATHMEY, JR., Chief Engineer Seaboard Air Line, Norfolk, Va.;
A. S. CHEEVER, Chief Engineer Fitchburg Railroad, Boston, Mass.;
W. B. POLAND, Division Engineer Baltimore & Ohio Southwestern Railroad, Washington, Ind.;
G. S. CHEYNEY, Assistant Division Engineer New York Central & Hudson River Railroad, Buffalo, N. Y.;
J. B. MOLL, General Roadmaster Chicago, Milwaukee & St. Paul Railway, Chicago;
J. B. ROBINSON, Resident Engineer Southern Pacific Co., Sacramento, Cal.;
H. C. LANDON, Chief Engineer Buffalo & Susquehanna, Austin, Pa.;

Committee.

The President:—Have you anything to say in reference to the report of this Committee? I think we ought to be congratulated, in fact, that although the chairman and vice-chairman are not able to attend to this matter, we still have a report.

Mr. Thomas Appleton, Chief Engineer Copper Range Railroad:—There is one subject which I think the Track Committee might well consider, and that is the advisability of using heavier rails and a less number of ties. Some two years ago, when rails were much lower in price than they are now, I thought that I could demonstrate, to my own satisfaction at least, that it would be economical for roads having a heavy business to increase the weight of rail and decrease the number of ties in the track. Track labor goes largely into the renewal and tamping of ties, and if the number of ties was reduced, the amount of this class of work would be reduced also. The cost of ties had been increasing and the price of rails diminishing, so that the proposition was an attractive one. I found it difficult to get statistics upon which to base the necessary calculations, and the conditions varied so much in different parts of the country that a universal rule was out of the question.

There is no difficulty in getting a rail strong enough to carry the loads imposed upon it, if the supports are all right. A seventy-five-pound rail does not require bearings every two feet if the bearings give substantial support. A great deal depends upon the character of the ballast used. At present the rise in the price of rails gives the question a different aspect. I believe that it would be economical to use larger ties and a less number of them, even if we maintain the same aggregate amount of bearing surface, as the number of ties to be tamped and renewed and of spikes to be driven would be less.

My investigations showed that in a given case, where the cost of ties was known and the cost of renewing them could be closely estimated, that I could prove my proposition in either way by varying the rate of interest charged on cost of material and labor.

While it may not be a matter for the Track Committee exclusively, it would be a good thing for the Association to consider what decides the rate of interest to be charged on first cost of projected improvements. For instance, we make an estimate of cost of remodeling a switching yard, and find that if the yard is rebuilt the same work can be done with one less switching crew, and a saving of so many dollars per year can be shown. But what of the interest on the investment—that silent, never idle factor that is working 365 days every year? Some rate of interest must be assumed in order to estimate the value of the projected improvement. A high rate of interest might kill the project and a low rate carry it through with a handsome margin.

The President:—I would like to say to the Committee on that subject that our road went into the question, and we came to the conclusion that we wanted to use a heavier rail and more ties, and found that was economy. The most economical track you can have is the most stable track. The value of the increase in the weight of rails is not to prolong its life or its wearing qualities. You get the maximum amount of wear out of a rail in the thirty-second of an inch of the outside. To secure a stable track it is necessary to have a stiff rail, and you must consider it in the form of a series of bridges or girders supported by piers. The heavier you can make the girder and the closer together you can put the support, the more stability

you get in the girder. What tears our track to pieces is not entirely the vertical weight that goes on it, but it is the flexure of the track, perhaps due to the flexure of the rail over the ties. This causes the ties to become loose, or may be due to the flexibility of the soil, or the disturbance of the ballast and the soil together, due to the impact and the weight of the train running over it. What we should strive to arrive at is stability, and the stiffer you can make the track, the heavier your rail, and the nearer your supports are under the rail, and the more ballast you have, the more economical it will be to keep up the track and maintain a strong track.

Mr. Cushing, Engineer Maintenance-of-Way Pennsylvania Lines West:—Mr. President, I heartily re-echo your remarks. We have been away behind the transportation department in keeping up with the increased weight of motive power. Our track has always been attacked when any question of increased motive power has been suggested, simply because we have been lagging behind. We have never led the procession. We have always followed in the rear, but it is time now to lead the procession.

The question of ties is going in the wrong direction, as it is not fewer ties per rail which are desirable. That was the first idea that seemed to prevail when the heavier rail was purchased, but a short experience with the fewer number of ties soon convinced me that it was a mistake. What we gained in the increased rail we lost at once by decreasing the support under the rail. At best, the supports by which we transmit loads to the roadbed are too small, and possibly we can never get them large enough. I think the ties should be as close together as will permit us to properly surface the track when required. That means at least as many ties as we use at the present time, and they should be as close together as will allow a shovel to be placed between them. A scientific investigation of the load-carrying power of the subgrade, for weights transmitted through the ties and the ballast, will show that the heavy weights of locomotives in use at the present time, and which may be increased at any time, will make it necessary to have all the bearing power we can get from the ties.

In taking up this question of track, one of the most important questions to start with is the relation between wheel

gauge and track gauge. It is a question which has never been dealt with in conjunction by motive power and maintenance-of-way departments. It is really a serious matter, as shown by the severe wrenching of our frog guard rails and other guard rails, due to the variety of gauge of motive power and car wheels in use to-day. There are limits of the Master Car Builders in the matter of wheel gauge which will allow both wheels to scrape as they pass through the flangeway. That is a very bad condition of affairs, and yet is a fact, and I think it is about time that the engineers proclaim their views on the subject.

The President:—There is one small matter here that I have made a note of. The members of the Association may have met the same problem and may have solved it in the same way. On the Illinois Central Railroad we have had a great deal of difficulty, as all railroads have, in the maintenance of the joints at the highway crossings. These crossings, of course, are planked, and a section boss never likes to rip up these planks or disturb them. He does not notice the low joint there, as they are not so noticeable as at other points. At one time we considered the question of getting enough sixty-foot rails to intersperse with the other rails, so we would have the joints come inside the limits of the crossing. The other day I went over our Springfield Division. The men were laying new rails, and I found the Roadmaster solved the problem in this way: When they approached a highway crossing they measured the distance to it and used a few of their short rails, and so arranged that they would not have a joint come inside the limits of the planking.

Mr. H. G. Kelley, Chief Engineer Minneapolis & St. Louis:—In connection with this discussion upon track and its maintenance, I would like to call the attention of the Committee to the effect upon track maintenance due to the details in design of motive power. It has been my misfortune to run against one item of this kind three times.

Opposite Cairo, some three years ago, a very heavy switch engine was sent into the yard. The switches were all stubs, and almost immediately after this switch engine commenced operating the gauge was spread on every switch to such an extent as to bend the switch rails and cause constant derailments. The motive power department naturally blamed it upon

the track, and, upon the other hand, the track department claimed that the trouble was due to some defect of the engine. It was solved at last by noticing that the buffer castings between the engine and the tank were both plane surfaces. Whenever the engine backed up with a string of cars, these two perfectly flat planes coming together with a heavy train behind them permitted no play between the engine and tank. The result was the engine backing up would tear out any switch ever put in.

The casting upon the tank was then made with a convex radial surface, and the trouble ceased at once. It occurred again at another terminal yard on the Mississippi River, where the same difficulty was found to exist, and was remedied by the same method.

On the road with which I am now associated we put some heavy Mogul engines into service this last fall. Immediately all the stub switches on the road went to pieces as fast as these engines backed over them, and after three months of trouble the convex castings are being put on the tanks. These engines came from one of the largest locomotive works in the country, and it is singular to me that the matter had not been brought to the designer's attention before. It does not seem probable that I should be the only one to have trouble of this kind, but I believe it to be suggestive of some of the difficulties which maintenance-of-way departments meet, and which are due to the details of design of motive power and rolling-stock.

Mr. A. W. Sullivan, General Superintendent Illinois Central:—Mr. Chairman, I would like to suggest to this Committee the necessity for establishing a capacity for tracks. We have capacity for locomotives, for cars and for bridges; we want a capacity for tracks. In other words, given a certain specification of track, what is that track capable of safely carrying, both as to weights of load and as to speed? I don't know of any way in which the use of track could be better regulated than by establishing a standard of service which the track can normally bear; and while I don't know that it has ever been done, it doesn't seem to me to be an impossible thing to do, because of the fact that the specifications of the track and the specifications of the rolling-stock that make use of it can be so ad-

justed mechanically that the defects which have been mentioned by the last speaker will not be normal to its use, but the things that are normal to its use should be regulated or gauged by some system that will admit of developing the highest use of the track. At the present time there is no means of knowing what advantage accrues from the substitution of a heavy rail for a light rail, of stone ballast for other forms of ballast, or from any of the material improvements which are being made from year to year in tracks, except as expressed in the duration of the track. To my mind that is not the only consideration. The duration of the track happens to be the element in which I am least concerned personally, but I am concerned in knowing what the limit of safety is in the use of the track. My position is that of using the track to its fullest extent; in other words, to get just as close to the limit in the normal use of the track as it is capable of bearing without injury, leaving the question of its economical use to be adjusted as between the tonnage that is moved over it and the length of service which it will endure. It has occurred to me that some measure of capacity might be developed. For instance, we will assume that a sixty-pound rail is capable of safely carrying trains (and it shouldn't make any difference whether they are freight or passenger) at a speed of sixty miles an hour. Is it a safe proposition to assume that a seventy-pound rail is good for seventy miles an hour, an eighty-pound rail for eighty, and a hundred-pound rail for one hundred miles an hour? The idea underlying that thought is that the increase in the weight of the rail should carry with it capacity for a superior use. It is not sufficient, in my mind at least, to change from a sixty to an eighty pound rail merely to have the rail last fifteen years instead of ten years. There must be with that change the opportunity for a higher use, and that higher use means the capacity to carry much heavier weights and to move at much higher rates of speed. The determination of the capacity of track, the capacity of its use rather, would be of great value in many ways other than that of the transportation service alone, because it would have an effect upon the rolling-stock. It would determine the limitations, both of the locomotives and cars, in their relation to the track. I do not think it is quite a fair proposition to expect a track to carry all weights of cars at any rate of speed

and to consider that use normal. There should be certain relations established between the physical construction of the track and the uses to which it may be put. We should know what those limits are within which such use can be considered normal. I hope this Committee will consider that question within the range of the subjects that come under the general heading of "Track."

Mr. D. W. Lum, Assistant General Superintendent Maintenance Southern Railway:—The track department has, and always will have, a very difficult matter in answering that question. An engine, or a bridge, with which we are perhaps more familiar, may be calculated and proportioned with exactness. The members may be adjusted with exact reference to each other, so that the bridge will be strong. An engine may be so constructed and proportioned and the various members so calculated that it will be of uniform strength, and it then may be classed as able to perform so much service. Unfortunately, we have to depend on the earth for our foundation. The parts of the engine, you manufacture; the earth, you take as you find it. The earth may be of a certain kind; a certain section may be of certain strength, and we may know is capable of supporting such a load, and we may be able to class the rail with the engine—an engine of so much capacity, a rail of so much capacity. The ties may have a certain strength, and we may so class them. A certain amount of ballast may act as a cushion to transfer the load from the rail and tie to the earth. It is probably the experience of all of you that track that will stand up, as the trackmen say, at one point, will utterly fail at another. You may pass through a rock cut here, and after putting a certain amount of ballast under the tie, you can then say to the motive power department: "That track is good for such a load or for such a service." Passing from the rock cut, you may encounter a marsh that may have been giving you trouble for many years, and may be now unreliable. There may be other places where you depend on the soft roadbeds that will perhaps take ten years to settle, that you cannot absolutely measure as to their capacity, and I doubt if we will ever be able to say of a continuous line of road, "This is the exact limit of that roadbed." We may say, "This is the limit of the rail, of the tie, of a foot of ballast;" but we do not know what

the limit of the natural material which we are availing ourselves of can be. Therefore, I do not think we will ever be able to specify so near the line as we may work in bridge construction or in motive power construction. (Applause.)

Mr. F. H. McGuigan, General Superintendent Grand Trunk Railway:—Inasmuch as all the suggestions which have been offered up to the present time have come from representatives of the greater railway systems (a majority of which usually provide ample funds and necessary facilities for properly maintaining their tracks), we must warn you not to lose sight of the fact that these great systems represent less than half the railway mileage of this continent. The smaller lines, representing a large majority of the mileage, being restricted in their expenditures by their limited earnings, cannot aspire to the perfect conditions which many gentlemen have described; therefore, I should like to suggest that if the Committee can point out a way in which these lighter and less fortunate lines can maintain their tracks safely and more economically than at present, they will confer upon such roads an immense benefit.

The President:—Have the Committee anything further to offer? They have received a great deal of good advice. We would like to get back at them in some other way.

We will now call on the Committee on Bridges and Trestles. Gentlemen, I take pleasure in introducing Mr. McGonagle, the vice-chairman of the Committee, who will read the report.

Mr. W. A. McGonagle, Resident Engineer and Superintendent Bridges and Buildings, Duluth & Iron Range Railroad:—Mr. President and gentlemen, I regret very much the inability of Mr. Bates, the chairman of this Committee, to be present. The Committee fully expected his presence, and relied upon him for the formal report. He is seriously ill with la grippe, and will not be able to be present at all at any of our meetings. The Committee, at a meeting to-day, very kindly allowed me to write a report, stipulating that I should not say anything for which the convention should jump upon them, so if there is any jumping to do, you will please do it on me.

REPORT OF COMMITTEE VII.—ON BRIDGES AND TRESTLES.

To the American Railway Engineering and Maintenance-of-Way Association:

The Committee on Subject 7—Bridges and Trestles—can only, at this time, submit a brief outline upon which to elaborate a formal report at our next annual meeting.

The subject is a broad one and so vital in its relations to the safety of the traveling public, as well as to the vast property interests involved, that it demands earnest and careful study and expert knowledge to develop the best plans for future guidance.

We are in an age of expansion, and nowhere is this fact more in evidence than in the rapidly increasing unit loads passing over our bridges and trestles of the present period. Bridges that were considered to be far in excess of the requirements of ten years ago are to-day considered with suspicion by those maintenance-of-way engineers who are responsible for their safety, and the question, "What shall we do with our old bridges?" is one of the most serious that confronts the managers of our railways to-day.

Your Committee believe that the best interests of the Association will be served by limiting the sphere of the first formal report at our next annual meeting to the subject of bridges and trestles in iron, steel and wood, believing that the time allotted to the Committee will be fully occupied by a careful consideration and discussion of this branch of our subject, and for this purpose we hope that each member of our Association, who is by experience qualified to give accurate data on this subject, will come forth without further solicitation and give to our members, through the Committee, the benefit of his experience. The very fact of this convention is evidence that the barriers, largely imaginary, heretofore existing between the railroads, are broken down, and that each can learn something from the other. We thus welcome a new era in the dissemination of practical knowledge among the different railroads of our country.

In regard to the subject of iron bridges and trestles, we recommend that each railroad submit to the Committee typical plans and specifications of its most modern structures, giving maximum span employed in

1. I-beam spans;
2. Plate-girder spans;
3. Lattice spans;
4. Pin-connected spans.

Also,

1. Methods of calculation;
2. Units employed;
3. Methods of inspection;
4. Methods of erection;
5. Methods of maintenance.

Your Committee hope from this time to recommend typical specifications and uniform practice as to length of spans, except in such cases where local conditions prevent the use of any standard plan.

In regard to the subject of wooden bridges, we recommend the same general procedure, giving the various modern types of wooden bridges used, the length of span employed, the kind of materials entering into the construction and the methods used for protection from the elements.

In regard to pile and trestle bridges, it is the intention of your Committee to prepare a tabulation of all the modern types of such bridges, giving in detail the different sizes and kinds of piles and bridge timbers used, size and shape of drift bolts used in various parts of the structure, methods of numbering, and methods of inspection and renewing. In order to prepare this tabulation we need, and respectfully invite, your co-operation.

Your Committee believe that a fund should be established and the different railroads invited and urged to contribute to the same, for the purpose of making careful experiments along the lines of the subjects which we have under consideration.

Your Committee invite the suggestions of members as to which part of the subject they particularly desire to be discussed, and we will endeavor to exert our energies along the lines indicated by them. Your Committee fully realize that this subject cannot be exhausted in any one year, or three years, but we hope, if aided by those having experience, to present from time to time themes for discussion which will draw out from those possessing special knowledge, and also from those possessing general knowledge, ideas for simplifying and systematizing the practice of our different railroad engineers.

ONWARD BATES, Engineer and Superintendent Bridges and Buildings Chicago, Milwaukee & St. Paul Railway, Chicago, Chairman;
W. A. MCGONAGLE, Resident Engineer and Superintendent Bridges and Buildings Duluth & Iron Range Railroad, Duluth, Minn., Vice-Chairman;
A. ZIESING, Consulting Engineer, Chicago;
I. O. WALKER, Division Engineer Nashville, Chattanooga & St. Louis, Paducah, Ky.;
E. BARRINGTON, Principal Assistant Engineer Vera Cruz & Pacific, Mexico, Mex.;
R. MODJESKI, Consulting Engineer, Chicago;
D. W. LUM, Assistant General Superintendent Maintenance Southern Railway, Washington, D. C.;
B. DOUGLAS, Bridge Engineer Michigan Central Railroad, Detroit, Mich.;
WILLIAM MICHEL, Engineer Maintenance-of-Way Hocking Valley Railroad, Columbus, Ohio;
T. L. CONDRON, Civil Engineer, Chicago;

Committee.

The President:—There was one thing that was talked over by the Board of Direction last night, which I will state to the Association, and particularly to the chairmen of the committees, that in order to save work for the chairmen of the committees,

whenever they want information from other roads they should address the Secretary, at the Monadnock Block, Chicago, the headquarters of the Association, and ask the Secretary to get certain information for them. He will correspond with different railroads and collect the information and turn it over to the chairman of the committee, and thus save the chairman of the committee a great deal of unnecessary correspondence with different roads, and it is expected and hoped that all railroads will have an understanding with their managing officers and engineering departments, so that any information that is called for from them by the Secretary of the Association will be promptly furnished.

Mr. Carothers:—Does that include compiling of information under the direction of the chairman?

The President:—The idea was that the Secretary should do that as far as possible, and a little later on that the chairman of any committee who found he had more work than he could promptly attend to would communicate with the Board of Direction and either ask that he have an assistant sent him in the form of an assistant secretary to work for him, or secure a limited appropriation from the Association to employ someone to help him do this work. That is, when the work becomes so large that we don't feel like sponging on the railroad companies, let our committee chairmen apply to the Secretary for assistance.

I think Mr. Peterson has some ideas on this question. I have talked with him from time to time, and I think he is competent to open the matter, particularly what shall be done with our old structures and to what extent we can safely overstrain them. The subject is open for discussion.

Mr. Peterson:—I do not care to give any opinion.

The President:—I will save Mr. Peterson that embarrassment. It is a fact we all have to face every day—every bridge engineer, every chief engineer and every managing officer in the United States. I presume there is not a railroad structure—possibly with the exception of some built within the last few years—but what at times is what the bridge engineers would technically call overstrained. It is quite a serious question with the managing officers of the railroads and the bridge engineers as to what extent it is advisable or safe to use those structures.

Mr. C. S. Churchill, Engineer Maintenance-of-Way Norfolk & Western:—Mr. Chairman, it seems to me that raises one point it might be well for the Committee to get information upon. We are asked every day when we expect to replace a bridge or temporarily trestle it. I think every railroad represented here has some method or some limit to which they work, and I think it time for the Committee to get a statement of what that limit is—at what strain per square inch in tension shall a bridge be trestled or removed.

The President:—To illustrate that question, generally the bridge engineer says: "I will figure the unit strain of the members of this structure at eight thousand pounds per square inch, and the elastic limit of this metal according to our specifications is thirty thousand, and the maximum strength fifty or sixty thousand pounds, and the motive power increases until finally the members of that bridge are subject to a strain of sixteen thousand pounds; and the managing officer calls him in and asks, "How much is this bridge overstrained?" And the bridge engineer says: "One hundred per cent." That would strike the passenger who rides on our trains as something eminently unsafe, whereas the fact is that the strain has not been over the elastic limit of the metal; it has not reached the point to which, theoretically, that metal can be safely strained. Then one engineer may make that statement on the basis of dead load, and another may make it on the basis of consideration of impact, and it is a question of a great deal of importance. Now, there is some limit, it seems to me, as to when we should strengthen a bridge or take it down and replace it. We would be following a rule which has been laid down and established as a safe one, if it were understood among engineers and managers that we couldn't go beyond the limit, and we would not assume the responsibilities, as a great many of us do, when we have to permit the use of a structure strained beyond the original theoretical limit. Of course there is this thing to consider about every structure, and that is the relative importance of the different members and the way they are strained and the details of construction—the location of your bridge, whether it is at the foot of a heavy grade, or at the end of a yard in your station, where your trains run over at full speed, and all that sort of thing—but it is one of the very annoying questions that railroad

managers and chief engineers and bridge engineers have to meet every day in the year. I do not think our Committee can do us a greater service than to investigate the subject along these lines.

Mr. M. H. Rogers, Chief Engineer Denver & Rio Grande Railroad:—I am very much obliged to you for the remarks and suggestions that you make. I am very glad to know that some of our roads, with an unlimited amount of capital, do overstrain their bridges. The Denver & Rio Grande road was started as a narrow-gauge system. When I was first associated with the road, some twenty years ago, we were using a thirty-pound rail, and everything in proportion. Now we use a very heavy rail with loads in proportion. In former years we built some iron and steel bridges for the then narrow-gauge lines, that are now deficient for standard-gauge requirements. Some three or four years ago the President and General Manager took up the matter with me carefully, and just before I left Denver for Chicago I received notification of an order for some new freight engines, which load to the maximum our bridges—our strong, heavy bridges, that were going to be heavy enough for anything we would have for years to come. We must meet the problem and take out the remaining narrow-gauge bridges on our standard-gauge lines and remove them to the narrow-gauge lines or strengthen them for heavy standard-gauge service.

If the Committee do take up the question of strengthening bridges or renewing them, it will, I assure you, be a subject that will deeply interest us in the immediate future.

When we changed our main line from narrow to standard-gauge through the "Royal Gorge," reducing our curvature to ten and twelve-degree curves, doing as heavy work as was required by the original construction, we introduced spiral easements, adopting Searles' system. We found occasionally that we could scarcely get in the complete spiral if we used a ten-foot chord, the intervening tangent being too short. In these cases, to lengthen the tangent would have been such heavy work that it would have been practically impossible. Last summer we built twenty-seven miles of broad-gauge line. We had quite a number of high wooden trestles, averaging from thirty feet to ninety feet on the center line, with a side slope of from one in two to one in three. We used a twenty-foot, instead of

the usual sixteen-foot, space between bents. For stringers we used Oregon, or "Douglass," fir, forty feet long, twenty-four inches deep and eight inches wide—six stringers. The stringers were sprung to fit the curve and laid so as to form practically a continuous chord, and have so far proven entirely satisfactory.

The President:—Gentlemen, I believe we have given this Committee a good idea of what we would like to have them do between now and the time of the next meeting.

The Committee on Records, Accounts and Reports will please come forward.

Mr. H. F. White, Chief Engineer Burlington, Cedar Rapids & Northern, chairman of the Committee:—This Committee has had no meeting heretofore. It might be a different matter if the whole Committee had to do with the preparation of the report.

REPORT OF COMMITTEE XI.—ON RECORDS, ACCOUNTS AND REPORTS.

To the American Railway Engineering and Maintenance-of-Way Association:

The work of the Committee of which I have the honor to be the chairman differs from that of the other committees of the Association in that it deals with the records and cost of work done, while they have to do with the manner of accomplishing the work.

It is very important that accounts and records of all transactions should be accurate, clear and arranged in a manner that admits of easy reference, for the records of the past furnish us the only reliable means of estimating the future. Why is it that the estimate of nearly every piece of work falls short of the actual cost, if not because the cost of similar work in the past has not been accurately kept and properly classified?

The work of this Committee should begin with the notes of the location survey, recommending the manner in which to keep these; then, taking up the right-of-way deeds, with their numberless conditions and side agreements, all of which should be arranged for easy reference, and the original carefully preserved.

This Committee should recommend as to the scales of maps and profiles that form parts of the records of all railway companies, and what should be shown on them, and emphasize the importance of keeping them up to date.

On looking at the headings into which the subject-matter of this Committee's work has been divided by the Board of Direction, it would seem that, to be logical, the numbering of the last two heads should be transposed, number three being changed to number two. The accounts

are made up from the reports, and naturally come after them in point of time. Anyone who has had any experience in a maintenance-of-way office knows how hard it is to get an intelligent report from a section foreman, or even from those from whom better things are expected, even when printed blanks are used. They are apt to get the right item on the wrong line, or write it across several lines. The one thing that seems to claim their greatest effort is to give the total days worked correctly.

Material reports are generally less accurate than time reports. Now, unless the reports are accurate, what hope has the bookkeeper that he can present any figures that are worth anything? In view of these conditions, the Committee should recommend just as few and as simple reports of time and material used as will state how much was received, how much used, and what use was made of it; and, in the case of material, show what was on hand at the end of the month.

The form of miscellaneous reports, including accidents, fire claims, stock killed, and others of a casual nature, should be plain and concise, confined to facts rather than opinions.

The recommendations of the Committee as to accounts should contemplate only the accounts kept for the use of the maintenance-of-way department.

The Association of Railway Accountants, in connection with the Interstate Commerce Commission, has recommended a general form of accounts to be kept by the auditing departments of the railways, and this has, in some instances at least, been adopted by the railways.

Every officer in charge of maintenance-of-way reports to the accounting officer the expenses of his department for each month, in some prescribed form that conforms to the system of accounts that may be in use on his system of railway.

This Committee has eight members, and in order to get anything ready for the next annual meeting that might be called a report, it seems to the Chairman that the best method of procedure would be to assign one or two sub-heads to each member, and, after these reports have been written by the various members, and criticised by the other members, for the Chairman to combine them into the full report, which then should be submitted to each member.

In making its recommendations the Committee should bear in mind that all railways are not organized in the same manner, and that a report that would suit the organization in one case might not do in another.

For this reason the report should be somewhat elastic, so that it will be possible to change the minor details without affecting the value of the recommendations as a whole. The Committee should bear in mind that their report, even if indorsed by the whole Association, will be nothing but a recommendation, and its adoption by the railways will depend largely upon the work that enters into it and the judgment with which this work is directed.

H. F. WHITE, Chief Engineer Burlington, Cedar Rapids & Northern Railroad, Cedar Rapids, Iowa, Chairman;

Jos. MORRISON, Resident Engineer Central Vermont, St. Albans, Vt., Vice-Chairman;
L. F. GOODALE, Chief Engineer Burlington's Missouri Lines, St. Joseph, Mo.;
T. J. FRAZIER, Assistant Engineer Baltimore & Ohio Railroad, Zanesville, Ohio;
D. MCPHERSON, Division Engineer Canadian Pacific, Montreal, Can.;
HENRY ROHWER, Assistant Engineer Missouri Pacific, Sedalia, Mo.;
GEORGE HOULISTON, Division Engineer Western New York & Pennsylvania Railway, Buffalo, N. Y.;

Committee.

The President:—The subject is now open for discussion.

Mr. R. C. Barnard, Engineer Maintenance-of-Way Pennsylvania Lines West:—I notice that at the bottom of the first page of the report the Committee says: "On looking at the headings into which the subject-matter of this Committee's work has been divided by the Board of Direction, it would seem that to be logical the numbering of the last two heads should be transposed, number three being changed to number two." While making a change in the subjects to be considered, I would suggest that to them be added that of "Wages." This is an important topic, and I do not see that it is covered by any of the various committees, and this one is, in my opinion, the committee to which it should be delegated.

Mr. Whittelsey:—I had in mind the same thing, only in a different way—the name of this Committee, which now reads, "Records, Accounts and Reports," in my judgment, should read, "Reports, Records and Accounts." We first make a record, and report; then we record the report, and afterward we make up our account.

The President:—These suggestions will be considered by the Committee and also by the Board in rearranging the subheading. A little later on the work of this Committee is going to be very important, and while it may be overshadowed by some more important subject which has to come before it, following the outline of what one of the gentlemen has just said, I think we have to make the record, then report, and then account for it. It is so late, if there is nothing further we will excuse the Committee and accept their report and allow them to report at greater length at the next meeting.

The next is the Committee on Signs, Fences, Crossings,

etc. I have the pleasure of introducing Mr. Wilson, the vice-chairman of the Committee.

Mr. Wilson:—This Committee has no report to make, because the Committee has had no meeting, and the chairman has no paper to read, because the chairman, as I understand it, is in Europe. The few remarks that I will make are those simply of the vice-chairman, on the method which will probably be adopted by this Committee, if his suggestions shall be accepted. I think that we have enough subject-matter set out in the organization of this Association to last for a very long time, and it does not seem to me that the Committee should attempt to cover all the subjects that are assigned to it in any one report. Therefore, I think that we should select, perhaps, only a single subject for one year's work, or perhaps two, and possibly only one part of that subject. The subject that should be selected should be the one that would be of the most common interest to all the members or to the railways which they represent. In the listing of the subjects assigned to this Committee it occurs to me that one of the most important is that of highway crossings, and one of the most important subheads is the protection of highway crossings at grade. Under that head should be arranged the various methods of protection in the order of their merit. It seems to me that one subject will be a good deal more than this Committee can accomplish in one year. Coming down to the second subject, it seems to me that we should consider the question of signs. That looks to be very unimportant, but there are certain classes of signs, such as those which are used to notify the trainmen and signs which are used to notify the public, upon which every member of this Association would like to have the indorsement of the Association as to the proper kind of a sign to erect for these purposes. There are other classes of signs which are unimportant and which should be treated in a very superficial way. Such a sign would be a station sign, of which we can hardly recommend a class or a type, because the station sign, like the painting of the coaches, is one which every railroad chooses to select for itself for more reasons than one. Very often it is an advertising feature.

My idea of the Committee's work is simply that the Committee will be as successful as the members of the Association

will make it. Being very largely the mouthpiece of the Association, the chairman of the Committee can do no more than that in which the members of the Committee will assist him in doing. All he can do with the information which they gather up is to present it to the Association, with the views and criticisms of the Committee, and which would be nothing more than the crystallization of the opinion of the members of the Association.

If we get no information from the members of the Association the Committee will do no work. And if the Committee does not work, the chairman has no report to make.

My idea of the method of collecting that information would be to formulate questions and simply arrange these and the answers, and then, perhaps, have one meeting only of the Committee prior to the annual meeting, upon the whole subject. Then the entire matter can be gone over and the report made up and presented. The rest of the work, it seems to me, could be done by correspondence, but there should be at least one meeting of the entire Committee. Even that might not be sufficient unless the Committee itself can do the work, which I believe can be done by correspondence.

The President:—The subject of this Committee is now under consideration. We would be glad to hear from you on it. The question of highway crossings is a very important one and has to do with track elevation matters and overhead crossings, which, in this city, have cost millions of dollars.

Mr. Oborne:—"Cattle-guards" is the most important subject that we know of under the head of the work of this Committee, and I suppose it is really the most important one of the whole list. The representatives of many of the Western roads will bear me out in saying that there are few, if any, positive surface cattle-guards.

The President:—On our road we have a surface guard in some parts of Iowa which is made of wooden slats. We make it at a cost of five or six dollars for each guard, and we have no trouble in keeping the cattle out. In other parts of the country they have very elaborate guards and sometimes they work and sometimes they don't. Down in the South we have the old-fashioned pit guards, and the cattle have learned to walk the rails.

Mr. Whittelsey:—Our West Virginia cattle are educated and furnished with a copy of the schedule.

Mr. McDonald:—I think the proper solution of the question would be to have standard cattle.

Mr. Barnard:—I would suggest to the Committee that they look over the laws of the different States, pertaining to highway crossings, with a view of ascertaining what, if any, protection is afforded the railroads against the opening of new road crossings.

The President:—In some of the States it is specified what the grade should be, and in some of the cities there are regulations relative to the grade crossings. We may spend millions of dollars on grade crossings, and probably a block away the city will open up a street across our grade, and we will be awarded perhaps one dollar damages. It seems to me this Committee has a very wide field to work in to find out not only what the railroads are doing, but the different governments of the city and State organization—what they are doing in the way of assisting and joining with the railroads in eliminating grade crossings. It may be that we may be able to educate the public in territories where they are not educated upon these matters, and thus get their aid in assisting in solving this problem, and in bearing a portion of the expenses. In Chicago the policy is to force the entire expense on the railroad, except as provided in one or two of the later ordinances.

In a few of these cases there is a ray of light in this matter relative to railroad companies, in that they are freed from damages due to the elevation of their track and the construction of their subways. A provision is made that if additional streets are opened it shall not only be done at the expense of the city, but that they shall put up the money before the work is done. As to the streets already existing, it is all put on the railroads. In some of the States it is divided between local governments and the railroads.

In respect to the cattle-guards, the question of what would be a standard cattle-guard is covered by law in some States, and the Committee should look into that question and also into the question as to the stock laws in the different States, and see what bearing that has upon the question of cattle-guards.

Mr. Carothers:—It seems to me that the work of this Committee can be elaborated very much; for instance, they might take up the question of tramps—that comes under the head of the sign, the crossing, the cattle-guard and the other protections.

The President:—Are there any further remarks to make to this Committee about its work, or has the Committee anything further to offer themselves?

This is the last of our Standing Committees, and it seems to me that the Association ought to congratulate itself on the amount of work that we have obtained from these committee chairmen and the members of the committees in the short time they have had to prepare these reports. They were only notified about six weeks ago, and the results that we have received from their work are very gratifying. With the Board of Direction, one of the principles of our organization is that the Board shall attend to all general business of the organization, so that the Association can devote almost all of its time to the general direction of the work and the discussion of the papers.

I presume that we should have a motion receiving these reports and thanking the committees for the work that they have done. We do not discharge them, however, for they are permanent Standing Committees, and we should refer the reports to the Publication Committee for auditing and printing. Last night the Committee authorized the printing of the reports received yesterday, and they will be printed and forwarded to the individual members at an early date.

Is there any motion before the house with reference to this? If there are no objections I will consider that motion made and seconded.

The motion was unanimously carried.

Mr. McNab:—May I be allowed a few moments. It occurs to me that there are many members of this Association who are also members of the American Society of Civil Engineers, and on looking over the transactions of that body for some years back, one finds quite a number of papers referring to railway matters and to maintenance-of-way matters generally. I think it would be a graceful tribute to this Association if any of our members had intended to write a paper for that society

on a railway subject, that it should be tendered to this Association instead. To-day I had the offer from a distinguished member of your Board of Direction to furnish details to the Committee of which I am a member, of a paper which he had at first intended to present to that society. I merely throw this out as a suggestion that the Chairman might lay before the meeting.

The President:—I am in a very delicate position in this matter, inasmuch as I happen to be the president of that society. I think the suggestion is very valuable, however, and members ought to consider the importance of presenting papers to this organization in the same way that they are presented to other engineering organizations, on any subject they see fit, and after these papers are read they can be referred to the appropriate committee and considered and discussed by that committee and form a part of their report, and be transmitted to the Association with their report at the next annual meeting.

If there is nothing further before the house the Secretary will make known the result of the election.

The Secretary:—Death has claimed four members of this Association during the past year, and a page in our publication will be set aside for the publication of their names and suitable memorials.

The President:—I would like to state that it would be eminently proper for us to publish a short memoir of these gentlemen. I was not acquainted with them. Their friends among our members should prepare a short memoir and furnish it to the Secretary, so it can be published. I would appoint committees to do that if I were acquainted with the names of the proper persons to appoint who are friends of these men.

The Secretary:—The result of the election is as follows:

For President—Mr. J. F. Wallace, of the Illinois Central Railroad, received 153 votes.

Mr. S. M. Felton, Chicago & Alton Railroad, who received one vote.

Mr. J. Kruttschnitt, Southern Pacific Company, who received one vote.

Mr. Wallace is elected.

For First Vice-President, for one year—Mr. P. A. Peterson, Canadian Pacific Railway, who received 155 votes.

For Second Vice-President, for two years—Mr. W. G. Curtis, Southern Pacific Company, who received 155 votes.

For Secretary—Mr. L. C. Fritch, Baltimore & Ohio Southwestern Railroad, who received 155 votes.

For Treasurer—Mr. W. S. Dawley, Chicago & Eastern Illinois Railroad, who received 155 votes.

For Directors for one year—Mr. W. K. McFarlin, Delaware, Lackawanna & Western, who received 155 votes, and Mr. Hunter McDonald, Nashville, Chattanooga & St. Louis, who received 155 votes.

For Directors for two years—Mr. D. J. Whittemore, Chicago, Milwaukee & St. Paul, who received 155 votes, and Mr. F. H. McGuigan, Grand Trunk, who received 155 votes.

For Directors for three years—Mr. A. Torrey, Michigan Central, who received 155 votes, and Mr. Thomas Rodd, Pennsylvania Lines West, who received 155 votes.

C. A. WILSON,
E. C. MACY,
C. DOUGHERTY.

The President:—There was some hesitancy about accepting the re-election—we declined at first, but the Board insisted that we accept, and it may be all right this time, but it reminds me of the experience I had when in college. A member of our class failed to show up one morning—it was just at the close of recitation (he had served in the army and was a cripple, and when he came in the boys used to call him Mr. Flat Wheel). He was a married man, and when he came in he whispered to the professor, in a stage whisper: "Professor, I had an occurrence in my family that prevented my getting here earlier to-day. It's a boy." The professor said: "All right, Mr. Nichols; it's all right this time, but never let it happen again."

Mr. W. G. Curtis, Southern Pacific Company:—I want to offer a resolution, and in so doing express the sentiments of the other gentlemen here. The resolution is as follows:

"Resolved, That the most appreciative thanks of this Association are due and are hereby extended to the President, Mr. J. F. Wallace, and to the Secretary, Mr. L. C. Fritch, for their untiring efforts in organizing and fostering the interests of this Association."

The resolution was unanimously adopted.

Mr. Curtis also offered the following resolution:

"Be it resolved, That a vote of thanks to Mr. J. M. Barr, of the Santa Fe Railroad, be extended to him for his kindness in furnishing a train for the members of this Association on their trip to Joliet."

This resolution was also adopted unanimously.

On motion, the meeting adjourned sine die.

CONSTITUTION.

ARTICLE I.

NAME, LOCATION, OBJECT AND MEANS.

SECTION 1. Name: The name of this Association shall be The American Railway Engineering and Maintenance-of-Way Association.

SECTION 2. Location: The offices of the Association shall be located in Chicago, Illinois.

SECTION 3. Object: The object of this Association shall be the advancement of knowledge pertaining to the scientific and economical location, construction, operation and maintenance of railroads.

SECTION 4. Means: The means to be employed for this purpose shall be as follows:

(*a*) Meetings for the reading and discussion of papers and for social intercourse.

(*b*) The investigation of matters pertaining to the Objects of this Association through Standing and Special Committees.

(*c*) The publication of papers, reports and discussions.

(*d*) The maintenance of a library.

ARTICLE II.

MEMBERSHIP.

SECTION 1. The Membership of this Association shall be divided into two classes, viz., Active and Honorary.

SECTION 2. Any Civil, Mechanical or Electrical Engineer, who has had five years' experience in the location, construction or maintenance of railroads; and any railroad official who is responsible for or has supervision of maintenance-of-way matters (embracing all grades of officials, from General Managers to Engineers of Maintenance-of-Way in charge of Divisions

inclusive), or railroad men bearing other titles but performing similar duties, shall be eligible for Active Membership.

SECTION 3. An Honorary Member shall be a person of acknowledged eminence in Railway Engineering or management. The number of Honorary Members shall be limited to ten. Honorary Members shall have all the rights of Active Members, except those of voting and holding office.

SECTION 4. Persons who are exclusively engaged in the sale or promotion of railroad patents or appliances shall not be eligible for membership in this Association.

ARTICLE III.

ADMISSIONS AND EXPULSIONS.

SECTION 1. The Charter Membership shall consist of all persons who are eligible for Membership under the provisions of Article II, and who may make application to the Secretary of the Preliminary Organization and receive a majority of the votes of the Organization Committee (composed of the Chairman and Secretary of the Preliminary Organization and the five persons constituting the Committee to prepare a Constitution and By-Laws), and pay the entrance fee, hereinafter provided for, within thirty days from the date of the adoption of this Constitution.

SECTION 2. After the expiration of said thirty days persons desiring Membership shall make application on the form prescribed by the Board of Direction, referring to five Members. The Board of Direction, through its Secretary or a Committee on Applications, shall make such investigations of the candidate's fitness as may be deemed necessary. The Secretary of the Association will furnish copies of the information obtained, together with a copy of the application, to each member of the Board of Direction. At any time, thirty days after the filing of the application, the admission of the applicant shall be voted on by the letter ballot by each Member of the Board of Direction. Affirmative votes by two-thirds of the Board of Direction shall elect the candidates.

SECTION 3. All elected candidates shall be duly notified, and shall subscribe to the Constitution and By-Laws, on forms prescribed by the Board of Direction, and transmit to the Sec-

retary the entrance fee hereinafter prescribed. If this provision be not complied with within six months the election shall be considered null and void.

SECTION 4. Honorary Members shall be proposed by at least ten Active Members to the Secretary. Each Member of the Board of Direction shall be furnished with a copy of the proposal, and after thirty days votes by ballot shall be taken by the Board of Direction thereon. If a candidate shall receive the unanimous vote of said Board he shall be declared elected an Honorary Member.

SECTION 5. Expulsions: On written charges preferred by ten or more Members, addressed to the Secretary of the Association, the Member complained of shall be served with a copy of said charges, and shall be called upon to show cause to the Board of Direction why he should not be expelled from the Association. Thirty days after said Member has been properly notified of the charges preferred against him, a vote shall be taken on his expulsion, and he may be expelled upon a two-thirds vote of the Board of Direction.

SECTION 6. Resignations: It shall be the duty of the Board of Direction to accept the resignation, tendered in writing, of any Member whose dues are fully paid up.

ARTICLE IV.

DUES.

SECTION 1. An initiation fee of $10.00 shall be payable to the Secretary with each application for Membership; this sum is to be returned to the applicant, however, who is not elected.

SECTION 2. The annual dues of this Association shall be $10.00, payable annually, during the first three months of each calendar year for the current year.

SECTION 3. Any person whose dues remain three months in arrears shall be notified of same by the Secretary. Should the dues in arrears not be paid prior to July 1st of each year, the delinquent Member shall lose his right to vote, but shall continue to receive the publications of the Association. Should his dues become nine months in arrears he shall be notified on the form prescribed by the Board of Direction; and if said

dues are not paid by the first of the following year, he shall forfeit his connection with the Association without further action.

SECTION 4. The Board of Direction may, however, extend the time of payment of dues and for the application of these penalties. The Board of Direction may also, for sufficient cause, excuse from payment the annual dues of any Member who, from ill health, advanced age or other good reason, is unable to pay his dues.

ARTICLE V.

OFFICERS.

SECTION 1. The officers of this Association shall consist of a President, two Vice-Presidents, six Directors, a Secretary and a Treasurer, who shall constitute the Board of Direction, in which the Government of the Association shall be vested; and who also shall act as Trustees and have the custody of all property belonging to the Association.

SECTION 2. The term of office of the President, Secretary and Treasurer shall be one year; of the Vice-Presidents two years, and of the Directors three years, with the exception, however, that at the first election of Officers after the adoption of this Constitution one Vice-President and two Directors shall be elected to serve one year; one Vice-President and two Directors for two years, and two Directors for three years; provided also, that after the first annual election one Vice-President and two Directors shall be elected each year in addition to the President, Secretary and Treasurer.

SECTION 3. The first election of officers under this Constitution shall be held by the Preliminary Organization of Charter Members immediately after the adoption of this Constitution, and the Officers so elected shall at once assume office. The term of each Officer shall begin at the close of each election and shall continue until his successor shall be elected at the expiration of his term as above set forth.

SECTION 4. Any vacancy in the office of President shall be filled by the senior Vice-President. A vacancy in the office of Vice-President shall be filled by election from among the Directors. In case of the disability or neglect in the performance of his duty of any Officer of this Association, the Board

of Direction shall have power to declare the office vacant. Vacancies in any office for the unexpired term shall be filled by the Board of Direction, except vacancy in office of President, as provided above.

SECTION 5. At least thirty days before each annual meeting, the Board of Direction, who shall act as a Nominating Committee, shall nominate to the Association a list of Officers for the next ensuing year. At any time prior to the thirty days before the annual meeting any ten Members of the Association shall have the right to nominate Officers for the ensuing year. Thirty days prior to each annual meeting the Secretary shall issue ballots to each Member of record in good standing, with a list of the several candidates to be voted upon, whose names shall be placed in alphabetical order if more than one person is nominated for any position. Ballots shall be placed in a sealed envelope, with the name of the Member voting indorsed thereon, and deposited with the Secretary at any time previous to the annual meeting. At the annual meeting three tellers shall be appointed, who shall open and count the ballots and report the result thereof. The majority of votes cast for any nominee shall determine his election.

ARTICLE VI.

MANAGEMENT.

SECTION 1. The President shall have a general supervision of the affairs of the Association. He shall preside at all meetings of the Association and at all meetings of the Board of Direction, and shall be ex-officio Member of all Committees.

The Vice-Presidents in order of seniority shall preside at meetings in the absence of the President, and discharge his duties in case of a vacancy in his office.

SECTION 2. The Board of Direction shall manage the affairs of the Association and shall have full power to control and regulate all matters not otherwise provided for in the Constitution.

SECTION 3. The Treasurer shall receive all moneys and deposit same in the name of the Association, and shall receipt to the Secretary therefor. He shall invest all funds not needed for current disbursements as shall be ordered by the Board of

Direction. He shall pay all bills, when properly certified and audited by the Board of Direction, and make such reports as may be called for by the Board of Direction.

SECTION 4. The Secretary shall be, under the direction of the President and Board of Direction, the Executive Officer of the Association. He shall attend all meetings of the Association and of the Board of Direction; prepare the business therefor, and duly record the proceedings thereof. He shall see that all moneys due the Association are carefully collected, and without loss transferred to the custody of the Treasurer. He shall personally certify to the accuracy of all bills or vouchers on which money is to be paid. He is to conduct the correspondence of the Association and keep a proper record thereof; and perform such other duties as may be assigned to him from time to time by the Board of Direction.

ARTICLE VII.

COMMITTEES.

SECTION 1. The Board of Direction shall meet within ten days after each annual meeting, and shall appoint from among its Members a Finance Committee of three, a Library Committee of three and a Committee on Publications of three. These Committees shall report to the Board of Direction and perform their duties under its supervision.

SECTION 2. The Finance Committee shall have immediate supervision of the accounts and financial affairs of the Association; shall approve all bills before payment, and shall make recommendations to the Board of Direction as to the investment of moneys and as to other financial matters.

SECTION 3. The Library Committee shall have general supervision of the Library of the Association and property therein.

SECTION 4. The Committee on Publications shall have general supervision of the publications of the Association.

SECTION 5. The Board of Direction may appoint such Standing Committees as it may deem best, to investigate, consider and report upon methods or appliances pertaining to the general question of railroad location, construction or maintenance.

SECTION 6. Special Committees to examine into and report upon any subject connected with the purposes of this Association may be appointed in the following manner:

A resolution to appoint such Committee, setting forth its objects and the number of its Members, may be presented by letter at any time to the Secretary of the Association, if signed by ten Active Members, and shall be referred by him to the Board of Direction, which, if it sees fit, may appoint such Committee. If the Board of Direction should not deem it expedient to appoint such Committee, the Members requesting the appointment of such Committee shall be notified, and the matter will then be referred to the Association at its next annual meeting and decided upon by ballot. If two-thirds of the Members present vote in favor of such Committee it shall be appointed by the President.

ARTICLE VIII.

MEETINGS.

SECTION 1. The annual meeting shall be held each year at such place and at such time as may be selected by the Board of Direction. Twenty-five Active Members shall constitute a quorum. Other meetings of the Association may be held at such times and at such places as the Board of Direction may select. The Secretary shall notify all Members of the time and place of all meetings of the Association at least thirty days in advance thereof.

SECTION 2. The Board of Direction shall meet at such times and at such places as a majority of the Board may determine. Five Members of the Board of Direction shall constitute a quorum.

SECTION 3. The order of business at meetings of the Association shall be as follows:

1. Reading of Minutes of last meeting.
2. Address of the President.
3. Admission of new Members.
4. Reports of the Secretary and Treasurer.
5. Reports of Standing Committees.
6. Reports of Special Committees.
7. Unfinished business.

8. New business.
9. Reading of papers and discussion thereof.
10. Election of Officers.
11. Adjournment.

This order of business, however, may be varied from, on a majority vote of Members present at any meeting.

ARTICLE IX.

AMENDMENTS.

SECTION 1. Proposed amendments to this Constitution must be made in writing and signed by not less than ten Active Members, and shall be acted upon in the following manner:

The amendments shall be presented to the Secretary, who shall send a copy of same to each Member of the Board of Direction as soon as received. If at the next meeting of the Board of Direction a majority of the Board are in favor of considering the proposed amendment, the matter shall then be submitted by letter to each Active Member of the Association for voting by ballot, and the result announced by the Secretary at the next annual meeting of the Association. In case two-thirds of the votes received are affirmative, the amendment shall be declared adopted. Amendments so adopted shall take effect thirty days thereafter.

LIST OF OFFICERS.

1900.

PRESIDENT.

J. F. WALLACE, Illinois Central Railroad, Chicago, Ill.

FIRST VICE-PRESIDENT—ONE YEAR.

P. A. PETERSON, Canadian Pacific Railway, Montreal, Can.

SECOND VICE-PRESIDENT—TWO YEARS.

W. G. CURTIS, Southern Pacific Company, San Francisco, Cal.

SECRETARY.

L. C. FRITCH, Baltimore & Ohio Southwestern Railroad, Washington, Ind. (Office, 1562 Monadnock, Chicago, Ill.)

TREASURER.

W. S. DAWLEY, Chicago & Eastern Illinois Railroad, Chicago, Ill.

DIRECTORS.

For Three Years.

A. TORREY, Michigan Central Railroad, Detroit, Mich.
THOS. RODD, Pennsylvania Lines West of Pittsburg, Pittsburg, Pa.

For Two Years.

D. J. WHITTEMORE, Chicago, Milwaukee & St. Paul, Chicago, Ill.
F. H. MCGUIGAN, Grand Trunk Railway, Montreal, Can.

For One Year.

W. K. MCFARLIN, Delaware, Lackawanna & Western, Hoboken, N. J.
HUNTER MCDONALD, Nashville, Chattanooga & St. Louis, Nashville, Tenn.

COMMITTEES OF THE BOARD OF DIRECTION.

ON FINANCE.

F. H. MCGUIGAN, Grand Trunk Railway, Chairman.
D. J. WHITTEMORE, Chicago, Milwaukee & St. Paul Railway.
W. S. DAWLEY, Chicago & Eastern Illinois Railroad.

ON PUBLICATIONS.

A. TORREY, Michigan Central Railroad, Chairman.
P. A. PETERSON, Canadian Pacific Railway.
W. G. CURTIS, Southern Pacific Company.
L. C. FRITCH, Baltimore & Ohio Southwestern Railroad.

ON LIBRARY.

THOS. RODD, Pennsylvania Lines West, Chairman.
W. K. MCFARLIN, Delaware, Lackawanna & Western.
HUNTER MCDONALD, Nashville, Chattanooga & St. Louis Railway.

LIST OF STANDING COMMITTEES AND OUTLINE OF COMMITTEE-WORK.

I.—GRADUATION.

J. B. BERRY, Chief Engineer Union Pacific, Omaha, Neb., Chairman.
W. MCNAB, Assistant Engineer Grand Trunk, Montreal, Vice-Chairman.
J. A. ATWOOD, Chief Engineer Pittsburg & Lake Erie, Pittsburg, Pa.
R. C. BARNARD, Engineer Maintenance-of-Way Pennsylvania Lines West, Cincinnati, O.
GEO. M. BROWN, Chief Engineer Saginaw District Pere Marquette Railway, Saginaw, Mich.
H. BALDWIN, Engineer Maintenance-of-Way Cleveland, Cincinnati, Chicago & St. Louis Railway, Indianapolis, Ind.
C. DOUGHERTY, Roadmaster Illinois Central Railroad, Chicago;

Committee.

1. Cuttings and Embankments:
   - *a* Standard cross-sections (variations of same, affected by local conditions).
2. Protection of Slopes:
   - *a* Sodding;
   - *b* Paving;
   - *c* Retaining walls;
   - *d* Planting willows, etc.;
   - *e* Sand-bagging;
   - *f* Drainage by surface ditches above, below, and on slopes, and by tiling.
3. Improvement of Grades and Alignment:
   - *a* Methods used;
   - *b* Limit of economy;
   - *c* Steam-shovel work.
4. Tunnels:
   - *a* Ventilation;
   - *b* Maintenance.

II.—BALLASTING.

R. MONTFORT, Chief Engineer Louisville & Nashville, Louisville, Chairman;
W. H. PEDDLE, General Superintendent Maintenance Southern Railway, Washington, D. C., Vice-Chairman;
A. MORDECAI, Assistant Chief Engineer Erie Railroad, Cleveland, Ohio;
J. R. LEIGHTY, Roadmaster Chicago & North-Western, Carroll, Iowa;
EDWARD SHELAH, General Roadmaster Wabash Railroad, Decatur, Ill.;
J. T. RICHARDS, Engineer Maintenance-of-Way Pennsylvania Railroad, Philadelphia, Pa.
H. U. WALLACE, Division Superintendent Illinois Central, Freeport, Ill.;
Committee.

1. Material:
   - *a* Stone—Size, quality;
   - *b* Gravel—Cementing, loose, sandy;
   - *c* Burnt clay—Quality, method of burning, etc.;
   - *d* Slag, cinder, and burnt shale;
   - *e* Chatts—Character;
   - *f* Earth;
   - *g* Dust prevention.
2. Standard cross-sections (variations, modified by material and other conditions).
3. Cost:
   - *a* Material alone;
   - *b* Loading;
   - *c* Transportation;
   - *d* Unloading;
   - *e* Placing under track; surfacing and dressing.
4. Methods:
   - *a* Handling material;
   - *b* Keeping trace of cost and accounts.
5. What constitutes ballasted track.

III.—TIES.

J. KRUTTSCHNITT, Vice-President and General Manager Southern Pacific, San Francisco, Cal., Chairman;
G. W. KITTREDGE, Chief Engineer Cleveland, Cincinnati, Chicago & St. Louis, Cincinnati, Ohio, Vice-Chairman;
J. J. FREY, President Florence & Cripple Creek Railway, Denver, Colo.;
W. L. DARLING, Assistant Chief Engineer Northern Pacific, St. Paul, Minn.;
O. CHANUTE, Consulting Engineer, Chicago;
WM. ARCHER, Principal Assistant Engineer Baltimore & Ohio Southwestern Railroad, Cincinnati, Ohio;
W. C. CUSHING, Engineer Maintenance-of-Way Pennsylvania Lines West, Pittsburg, Pa.;

LEWIS KINGMAN, Chief Engineer Mexican Central Railway, Mexico, Mex.;
J. C. NELSON, Division Engineer New York Central; New York;
Committee.

1. Material:
   a Wood—Various kinds;
   b Metal—Shapes, etc.
2. Preservation:
   a Consideration of methods and cost.
3. Inspection:
   a When purchasing;
   b When necessary to renew in track.
4. Cost:
   a Delivered at side of track;
   b Loading;
   c Transportation;
   d Local distribution;
   e Putting in track and spacing.
5. Disposition of old ties:
   a Method and cost of utilizing same;
   b Use for firewood;
   c Use for curbing, retaining walls and otherwise;
   d Burning.
6. Methods:
   a Handling tie question;
   b Reports and accounts.
7. General questions:
   a Preparing for track;
   b Piling for use;
   c Boring for spikes;
   d Planing or adzing for tie-plates;
   e Lining up on ends;
   f Marking for age in service;
   g Tie-plates.

IV.—RAIL.

ROBT. TRIMBLE, Principal Assistant Engineer Pennsylvania Lines West, Pittsburg, Pa., Chairman;
S. M. FELTON, President Chicago & Alton Railroad, Chicago, Vice-Chairman;
A. W. JOHNSTON, General Superintendent New York, Chicago & St. Louis, Cleveland, Ohio;
THOS. PURCELL, Superintendent Mexican National Railway, Matamoros, Mexico;
W. T. MANNING, Consulting Engineer Baltimore & Ohio Railroad, Baltimore, Md.;
R. W. HUNT, Consulting Engineer, Chicago;
C. E. WICKHAM, Division Engineer Chicago, Rock Island & Pacific, Chicago;

J. H. WALLACE, Assistant Engineer Maintenance-of-Way Southern Pacific, San Francisco, Cal.;
G. B. WOODWORTH, Rail Inspector Chicago, Milwaukee & St. Paul Railway, Chicago;

Committee.

1. General specifications:
   - *a* Chemical constituents;
   - *b* Mechanical manipulation;
   - *c* Inspection.
2. Standard sections:
   - *a* As to general form, considering differences of section as related to alignment, grades and traffic;
   - *b* As to weight, considering adoption of standard section of weight per yard.
3. Proper length of rails—reasons therefor.
4. Transportation.
5. Local distribution and handling.
6. Laying:
   - *a* Methods, single rails or strings;
   - *b* Expansion;
   - *c* Adzing ties, preparatory to laying.
7. Utilization of relieved rail:
   - *a* For patching rail of same kind in main line;
   - *b* For laying on branch lines;
   - *c* Passing tracks and sidings;
   - *d* Scrap;
   - *e* Care and treatment of relieved rail (re-rolling and careful sawing).

V.—TRACK.

E. A. HANDY, Chief Engineer Lake Shore & Michigan Southern, Cleveland, Ohio, Chairman;
H. F. BALDWIN, Chief Engineer Chicago & Alton, Chicago, Vice-Chairman;
S. B. FISHER, Chief Engineer Missouri, Kansas & Texas Railway, St. Louis, Mo.;
W. W. GWATHMEY, Jr., Chief Engineer Seaboard Air Line, Portsmouth, Va.;
A. S. CHEEVER, Chief Engineer Fitchburg Railroad, Boston, Mass.;
WM. B. POLAND, Division Engineer Baltimore & Ohio Southwestern, Washington, Ind.;
G. S. CHEYNEY, Assistant Division Engineer New York Central, Buffalo, N. Y.;
J. B. MOLL, General Roadmaster Chicago, Milwaukee & St. Paul, Chicago;
J. B. ROBINSON, Resident Engineer Southern Pacific Company, Sacramento, Cal.;
H. C. LANDON, Chief Engineer Buffalo & Susquehanna, Austin, Pa.;

Committee.

1. Maintenance of Line:
   - *a* Adjustment of tangents;
   - *b* Adjustment of curves, with consideration as to easement of curves;
   - *c* Methods used in securing and maintaining perfect line.
2. Maintenance of Surface:
   - *a* Elevation of curves, with special consideration as to amount and beginning and end of elevation, and as modified by location of curve and conditions of traffic;
   - *b* Vertical curves;
   - *c* Proper methods of tamping.
3. Maintenance of Gauge:
   - *a* Proper method of spiking;
   - *b* Allowance, if any, in gauge of curves, with consideration as to various practices;
   - *c* Methods used to prevent spreading of track and canting of rails.
4. Inspection of Track:
   - *a* Trackwalking, consideration as to when resorted to, and particular requirement of;
   - *b* Special inspection of switches, frogs, crossings, derailing points, interlocking plants, etc.; requirements;
   - *c* Inspection of bridges, trestles, culverts, etc., by trackmen.
5. Tools:
   - *a* Track tools, various kinds;
   - *b* Standard equipment for gangs;
   - *c* Hand-cars—types and use;
   - *d* Push-cars—types and use;
   - *e* Dump-cars;
   - *f* Method used in supplying and checking use of.
6. Frogs and Switches:
   - *a* Types for main line;
   - *b* Types for yards;
   - *c* Best angle for main line;
   - *d* Safety devices in connection therewith.
7. Crossings:
   - *a* Foundations and drainage;
   - *b* Types of crossings.
8. Guard-rails:
   - *a* Spacing of flange-way;
   - *b* Foot-guard protection.
9. Joints and Fastenings.
10. General Questions:
    - *a* Cleaning track;
    - *b* Cutting right-of-way, consideration as to time, etc.;
    - *c* Care of station grounds;
    - *d* Painting, white-washing, dressing up, etc.

VI.—BUILDINGS.

W. G. BERG, Chief Engineer Lehigh Valley Railroad, New York City, Chairman;
H. W. PARKHURST, Engineer Bridges and Buildings Illinois Central, Chicago, Vice-Chairman;
P. D. FORD, Chief Engineer Long Island Railroad, Richmond Hill, N. Y.;
E. C. MACY, Engineer Iowa Central, Marshalltown, Iowa;
C. E. BRYAN, Superintendent Maintenance-of-Way Ohio River Railroad, Parkersburg, W. Va.;
C. MILLARD, General Manager Chicago, Peoria & St. Louis Railway, Springfield, Ill.;
B. C. GOWEN, Chief Engineer Wisconsin & Michigan, Wausau, Wis.;
M. W. COOLEY, Assistant Engineer Baltimore & Ohio, Baltimore, Md.;
A. S. MARKLEY, Superintendent Bridges and Buildings Chicago & Eastern Illinois, Danville, Ill.;
C. T. NORTON, Superintendent Mexican International Railway, Porfirio Diaz, Mexico;
H. PIERCE, Engineer Maintenance-of-Way Chesapeake & Ohio, Huntington, W. Va.;
I. F. WHITE, Superintendent Tracks and Structures Cincinnati, Hamilton & Dayton Railway, Hamilton, Ohio;
G. W. VAUGHAN, Supervisor Bridges and Buildings, New York Central, New York, N. Y.;
J. D. ISAACS, Second Assistant Engineer Maintenance-of-Way Southern Pacific, San Francisco, Cal.;

Committee.

1. Passenger Station Buildings:
   a Material;
   b Standard plans.
2. Freight Station Buildings:
   a Material;
   b Standard plans.
3. Combination Stations.
4. Machine Shops (including engine-erecting, boiler, blacksmith, paint, car-building and repair-shop buildings, dry houses, transfer tables, etc.).
5. Round-houses (including turntables, engine pits, drop pits, cinder pits, etc.);
   Manner of handling cinders.
6. Coaling Stations:
   a Method of handling coal;
   b Cost per ton to handle.
7. Sand and Oil Houses.
8. Coal-houses for stations; watch-boxes; scale-houses; interlocking towers; water stations; icing stations.
9. Water tanks, pump-houses and track tanks.

10. Platforms:
    a Wooden;
    b Cement;
    c Brick;
    d Stone;
    e Cinder.
11. Elevators:
    a Transfer;
    b Storage;
    c Clipping and cleaning.
12. General Questions:
    a Painting;
    b Inspection of;
    c Fire protection;
    d Lighting plants and methods;
    e Heating methods.

VII.—BRIDGES AND TRESTLES.

ONWARD BATES, Engineer and Superintendent Bridges and Buildings Chicago, Milwaukee & St. Paul, Chicago, Chairman;
W. A. MCGONAGLE, Resident Engineer and Superintendent Bridges and Buildings Duluth & Iron Range Railroad, Duluth, Minn., Vice-Chairman;
A. ZIESING, Consulting Engineer, Chicago;
I. O. WALKER, Division Engineer Nashville, Chattanooga & St. Louis, Paducah, Ky.;
E. BARRINGTON, Principal Assistant Engineer Vera Cruz & Pacific Railway, Mexico, Mex.;
R. MODJESKI, Consulting Engineer, Chicago;
D. W. LUM, Assistant General Superintendent Maintenance Southern Railway, Washington, D. C.;
B. DOUGLAS, Bridge Engineer Michigan Central Railroad, Detroit, Mich.;
WILLIAM MICHEL, Engineer Maintenance-of-Way Hocking Valley Railroad, Columbus, Ohio;
T. L. CONDRON, Civil Engineer, Chicago;

Committee.

1. Iron Bridges:
    a Rolled I-beam spans; consideration as to limit of economical use;
    b Plate girders; consideration as to limit of economy in their use;
    c Truss spans; consideration as to various types;
    d Draw spans; consideration as to method of operation.
2. Wooden Bridges:
    a Character and various types;
    b Method of protection or care.

3. Trestles:
   a Iron; consideration as to comparative cost with wooden trestles;
   b Pile; length of spans; character and specifications of piling; protection in salt water; protection at ground line; limit of use; filling;
   c Frame bents; construction; bracing; custom in renewal, whether in whole or in part; filling;
   d Solid floor trestles.
4. Docks and Wharves:
   a Coal docks;
   b Ore docks;
   c Piers and slips;
   d Transfer facilities.
5. Miscellaneous:
   a Cost per foot—various types;
   b Inspection—practice regarding;
   c Painting—best method of protection from rust.

VIII.—MASONRY.

W. L. BRECKINRIDGE, Chief Engineer Chicago, Burlington & Quincy, Chicago, Chairman;
E. P. DAWLEY, Division Engineer New York, New Haven & Hartford, Boston, Mass., Vice-Chairman;
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W. E. HOYT, Consulting Engineer, Rochester, N. Y.;
F. S. STEVENS, Division Engineer Philadelphia & Reading, Reading, Pa.;
C. F. W. FELT, Chief Engineer Gulf, Colorado & Santa Fe, Galveston, Texas;
B. T. FENDALL, City Engineer, Baltimore, Md.;
F. M. BISBEE, Superintendent Track, Bridges and Buildings St. Louis & San Francisco, Springfield, Mo.;

Committee.

1. Bridge Masonry:
   a Abutments; various forms and economies resulting therefrom;
   b Piers, including foundations, coping, etc.; also cost of low piers, with use of steel bents, as against full-height piers;
   c Bridge seats, mud walls, wing walls, etc.
2. Arch Masonry:
   a Various types and advantages of same relative to local conditions;
   b Practice of use of arches in "T" abutments to save masonry;
   c Limit of economy in use as against span bridges.
3. Culvert Masonry:
   a Forms of;
   b Cover-plates, wall-plates, paving;
   c Use of rails for cover-plates, with brick or concrete in spaces.

4. Pipe Culverts:
   a Iron, water and gas pipes, considering foundations used in laying, thickness of pipe; limit of use as to number of lines of pipe and diameter;
   b End walls.
5. Wooden Box Drains:
   a When permitted.
6. Concrete Masonry.

IX.—SIGNS, FENCES, CROSSINGS AND CATTLE-GUARDS.

H. FERNSTROM, Chief Engineer Chicago Great Western, St. Paul, Minn., Chairman;
C. A. WILSON, Chief Engineer Cincinnati, Hamilton & Dayton, Cincinnati, Ohio, Vice-Chairman;
G. F. BIDWELL, General Manager Fremont, Elkhorn & Missouri Valley, Omaha, Neb.;
D. BONTECOU, Chief Engineer Kansas City, Fort Scott & Memphis, Kansas City, Mo.;
J. R. W. DAVIS, Engineer Maintenance-of-Way Erie Railroad, Jersey City, N. J.;
H. J. SLIFER, Superintendent Chicago & North-Western, Boone, Iowa;
W. SHEPARD, Chief Engineer Boston & Albany, Boston, Mass.;

1. Fences: *Committee.*
   a Wire—various kinds;
   b Posts used in wire fences;
   c Board fences;
   d Method regarding maintenance;
   e Snow fences.
2. Highway Crossings:
   a Overhead crossings;
   b Under crossings;
   c Surface crossings—consideration as to protection of same; planking; approaches;
   d Crossing gates—pneumatic, hydraulic, electrical or physical operation.
3. Cattle-guards:
   a Surface guards;
   b Pit guards;
   c Wing fences, to cattle-guards.
4. Signs:
   a Standard station signs;
   b Standard ring whistle posts;
   c Standard mile-posts;
   d Standard highway-crossing warnings;
   e Standard stop sign boards;
   f Standard yard-limit boards;
   g County, city-limit and state-line boards;
   h Bridge warnings;
   i Structure signs—method of indicating.

X.—SIGNALING AND INTERLOCKING PLANTS.

H. D. MILES, Signal Engineer Michigan Central Railroad, Detroit, Mich., Chairman;

F. W. SCARBOROUGH, Engineer Bridges and Signals Chesapeake & Ohio, Richmond, Va., Vice-Chairman;

W. J. GILLINGHAM, Jr., Signal Engineer Illinois Central, Chicago;

J. S. HOBSON, Signal Engineer Atchison, Topeka & Santa Fe Railroad, Topeka, Kan.;

A. H. SANFORD, Engineer Maintenance-of-Way Pennsylvania Lines West, Toledo, Ohio;

Committee.

1. Signals:
   - *a* Train-order signals;
   - *b* Distance signals;
   - *c* Block signals.
2. Interlocking Plants:
   - *a* Railway crossings protection;
   - *b* Switch connections;
   - *c* Operating yards.
3. Highway Crossings Signals:
   - *a* Various types;
   - *b* Mode of operation.
4. Miscellaneous Questions.

XI.—REPORTS, RECORDS AND ACCOUNTS.

H. F. WHITE, Chief Engineer Burlington, Cedar Rapids & Northern, Cedar Rapids, Iowa, Chairman;

JOSEPH MORRISON, Resident Engineer Central Vermont Railway, St. Albans, Vt., Vice-Chairman;

L. F. GOODALE, Chief Engineer Burlington's Missouri Lines, St. Joseph, Mo.;

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D. MCPHERSON, Division Engineer Canadian Pacific, Montreal, Canada;

HENRY ROHWER, Assistant Engineer Missouri Pacific, Sedalia, Mo.;

GEORGE HOULISTON, Division Engineer Western New York & Pennsylvania Railway, Buffalo, N. Y.;

Committee.

1. Reports:
   - *a* Labor reports, including method of reporting time worked, with classification of items, with a view of reaching uniformity in this regard;
   - *b* Material reports—various forms used in reporting material used to enable complete check to be had on all material used;
   - *c* Miscellaneous reports, such as accident, fire claims, stock killed, flood damage, etc.

2. Records:
   a Right-of-way records, deed records;
   b Station plats;
   c Profiles of road;
   d Alignment maps;
   e Lease records.
3. Accounts:
   a Labor accounts; consideration as to classification of distribution to various items of labor;
   b Material accounts; consideration as to method of charging out to various classes of work; whether individual accounts with each structure or general accounts;
   c Bills against other lines.

XII.—UNIFORM RULES, ORGANIZATION, TITLES, CODE, ETC.

D. D. CAROTHERS, Engineer Maintenance-of-Way Baltimore & Ohio Southwestern Railroad, Cincinnati, Ohio, Chairman;
W. J. WILGUS, Chief Engineer New York Central & Hudson River Railroad, New York, Vice-Chairman;
E. H. FITZHUGH, General Manager Central Vermont Railway, St. Albans, Vt.;
G. A. QUINLAN, Vice-President and General Manager Houston & Texas Central Railroad, Houston, Texas;
JAMES OBORNE, General Superintendent Canadian Pacific, Winnipeg, Man.;
T. F. WHITTELSEY, General Superintendent Toledo & Ohio Central Railway, Toledo;
C. S. CHURCHILL, Engineer Maintenance-of-Way Norfolk & Western, Roanoke, Va.;
J. T. MAHL, Engineer Maintenance-of-Way Southern Pacific, Houston, Texas;
F. B. HARRIMAN, Superintendent Illinois Central, Dubuque, Iowa;
Committee.

1. Proper Organization of the Maintenance-of-Way Department.
2. Code of titles, applicable uniformly over entire country.
3. Rules and Regulations governing employes in Maintenance-of-Way Department.
4. Code of Maintenance-of-Way Ethics.

XIII.—WATER SERVICE.

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G. H. WEBSTER, Engineer Maintenance-of-Way Manitoba & Northwestern, Winnipeg, Man.;
SAMUEL ROCKWELL, Principal Assistant Engineer Lake Shore & Michigan Southern, Cleveland, Ohio;

Committee.

1. Source of Supply:
   a Surface, method of impounding;
   b Subterranean, driven, drilled or open wells.
2. Method of Pumping and Supply:
   a Direct from tanks;
   b Through standpipes;
   c Through track tanks;
   d Cost of pumping;
   e City waterworks supplies;
   f Pumping machinery, boilers, etc.
3. Character of Water, giving analyses of good and bad water for engines; also use of compounds to counteract impurities.

XIV.—YARDS AND TERMINALS.

A. W. SULLIVAN, General Superintendent Illinois Central Railroad, Chicago, Chairman;
F. E. PARADIS, Chief Engineer Chicago Terminal Transfer Railroad, Chicago, Vice-Chairman;
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C. W. HOTCHKISS, Chief Engineer Chicago Transfer & Clearing Co., Chicago;
C. S. SIMS, JR., Engineer Maintenance-of-Way Pennsylvania Lines, Chicago;
W. S. KINNEAR, Principal Assistant Engineer Michigan Central Railroad, Detroit, Mich.;

Committee.

1. Freight Terminal Yards.
2. Passenger Terminal Yards.
3. Passing Sidings:
   a Best form of;
   b Economical length;
   c Location for passing track on double track.

4. Station Tracks:
   a Best forms; consideration as to convenience for teaming tracks, etc.);
   b Industrial tracks.
5. Gravity and Poling Yards.
6. Train Sheds:
   a Pocket sheds;
   b Through sheds;
   c Arrangement of tracks, etc.
7. "Y" tracks.

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Superintendent Union Elevated Railroad,
311 Fisher Building, Chicago, Ill.

NELSON, J. C.,
Division Engineer New York Central & Hudson River Railroad,
506 Grand Central Station, New York City.

NICHOL, J. H.,
Assistant Engineer West Jersey & Seashore Railway,
Camden, N. J.

NICHOLSON, F. L.,
Engineer Maintenance-of-Way Norfolk & Southern Railroad,
Norfolk, Va.

NORTON, CHARLES T.,
Superintendent Road Department Mexican International Railway,
Ciudad Porfirio Diaz, Mex.

O

OBORNE, JAMES,
General Superintendent Canadian Pacific Railway,
Winnipeg, Man.

P

PALMER, W. S.,
Resident Engineer Southern Pacific Company,
Oakland, Cal.

PAQUETTE, C. A.,
Superintendent Cleveland, Cincinnati, Chicago & St. Louis Railway, Indianapolis, Ind.

PARADIS, F. E.,
Chief Engineer Chicago Terminal Transfer Railroad,
Grand Central Passenger Station, Chicago, Ill.

PARKHURST, H. W.,
Engineer Bridges and Buildings Illinois Central Railroad,
Chicago, Ill.

PATTERSON, F. M.,
Assistant Roadmaster Hannibal & St. Joseph Railroad,
Brookfield, Mo.

PEDDLE, W. H.,
General Superintendent of Maintenance Southern Railway,
1300 Pennsylvania Avenue, Washington, D. C.

PENCE, WILLIAM D.,
Professor of Civil Engineering Purdue University,
Lafayette, Ind.

PETERSON, P. A., (First Vice-President),
Chief Engineer Canadian Pacific Railway,
Montreal, Canada.

PFAFFLIN, E. H.,
Chief Engineer Evansville & Terre Haute Railroad,
Evansville, Ind.

PHILBRICK, ALVAH,
Superintendent Illinois Central Railroad,
Memphis, Tenn.

PIERCE, H.,
Engineer Maintenance-of-Way Chesapeake & Ohio Railway,
Huntington, W. Va.

POLAND, WILLIAM B.,
Division Engineer Baltimore & Ohio Southwestern Railroad,
Washington, Ind.

PROUT, H. G.,
Chief Editor "Railroad Gazette,"
32 Park Place, New York, N. Y.

PURCELL, THOMAS,
Division Superintendent Mexican National Railroad,
Matamoros, Mex.

Q

QUINLAN, G. A.,
Vice-President and General Manager Houston & Texas Central
Railroad, Houston, Texas.

R

RAWN, I. G.,
General Superintendent Baltimore & Ohio Southwestern Railroad,
Cincinnati, Ohio.

RAYMER, A. R.,
Assistant Engineer Pittsburg & Lake Erie Railroad,
Pittsburg, Pa.

RICHARDS, J. T.,
Engineer Maintenance-of-Way Pennsylvania Railroad,
Philadelphia, Pa.

RICHARDS, O. D.,
Chief Engineer Ann Arbor Railroad,
Toledo, Ohio.

ROBINSON, H. P.,
Editor "Railway Age,"
Chicago, Ill.

ROBINSON, J. B.,
Resident Engineer Southern Pacific Company,
Sacramento, Cal.

ROCKWELL, SAMUEL,
Principal Assistant Engineer Lake Shore & Michigan Southern
Railway, Cleveland, Ohio.

RODD, THOMAS, (Director),
Chief Engineer Pennsylvania Lines West,
Pittsburg, Pa.

RODGERS, J. G.,
Superintendent New York, Philadelphia & Norfolk Railroad,
Cape Charles, Va.

ROGERS, M. H.,
Chief Engineer Denver & Rio Grande Railroad,
Denver, Colo.

ROHWER, HENRY,
Assistant Engineer Missouri Pacific Railway,
Sedalia, Mo.

S

SABIN, A. T.,
Assistant Engineer Illinois Central Railroad,
Covington, Tenn.

SAFFORD, H. R.,
Roadmaster Illinois Central Railroad,
Clinton, Ill.

SANDERS, E. B.,
Assistant Engineer Southern Railway,
1300 Pennsylvania Avenue, Washington, D. C.

SANFORD, A. H.,
Engineer Maintenance-of-Way Pennsylvania Lines West,
Toledo, Ohio.

SCARBOROUGH, F. W.,
Engineer Bridges and Signals Chesapeake & Ohio Railway,
Richmond, Va.

SCHINDLER, A. D.,
Division Superintendent San Francisco & San Joaquin Valley Railway, Stockton, Cal.

SCHMIDT, H. W.,
Chief Engineer and Superintendent Centralia & Chester Railroad,
Sparta, Ill.

SHAW, LOUIS,
Civil Engineer U. S. Government,
La Crosse, Wis.

SHEAHAN, DENNIS,
Roadmaster Illinois Central Railroad,
Memphis, Tenn.

SHELAH, EDWARD,
General Roadmaster Wabash Railroad,
Decatur, Ill.

SHEPARD, W.,
Chief Engineer Boston & Albany Railroad,
Boston, Mass.

SHOBER, S. L., Jr.,
Assistant Engineer Pennsylvania Railroad,
Tyrone, Pa.

SIMS, C. S., Jr.,
Engineer Maintenance-of-Way Pennsylvania Lines West,
Chicago, Ill.

SLIFER, H. J.,
Superintendent Chicago & North-Western Railway,
Boone, Iowa.

SLOAN, DAVID,
Chief Engineer Illinois Central Railroad,
Chicago, Ill.

SOUTHGATE, R.,
Superintendent Track, Bridges and Buildings Southern Railway,
Charlotte, N. C.

SROUFE, C. C.,
Resident Engineer Southern Pacific Company,
Tucson, Ariz.

STEINBECK, E. J.,
Roadmaster Illinois Central Railroad,
Freeport, Ill.

STEVENS, F. S.,
Division Engineer Philadelphia & Reading Railway,
Reading, Pa.

STOREY, W. B., Jr.,
Engineer and General Superintendent San Francisco & San Joaquin Valley Railway, San Francisco, Cal.

SULLIVAN, A. W.,
General Superintendent Illinois Central Railroad, Chicago, Ill.

SWAINE, E. L.,
Resident Engineer Southern Pacific Company, Los Angeles, Cal.

T

TAIT, THOMAS,
Manager Eastern Lines, Canadian Pacific Railway, Montreal, Can.

TAYLOR, J. W.,
Chief Engineer Terminal Railroad Assn., and Merchants' Bridge Ter. Railway, St. Louis, Mo.

THOMAS, J. W., Jr.,
General Manager Nashville, Chattanooga & St. Louis Railway, Nashville, Tenn.

THOMPSON, BENJAMIN,
Resident Engineer Southern Railway, Greensboro, N. C.

TORREY, A., (Director),
Chief Engineer Michigan Central Railroad, Detroit, Mich.

TRATMAN, E. E. RUSSELL,
Resident Editor "Engineering News," Monadnock Block, Chicago, Ill.

TRIMBLE, ROBERT,
Principal Assistant Engineer Pennsylvania Lines West, Pittsburg, Pa.

TWEEDY, R. B.,
Chief Engineer Wisconsin Central Lines, Milwaukee, Wis.

U

UNDERWOOD, F. D.,
Second Vice-President and General Manager Baltimore & Ohio Railroad, Baltimore, Md.

V

VAN VLECK, W. G.,
General Manager Atlantic System Southern Pacific Company, Houston, Texas.

VAUGHAN, G. W.,
Supervisor Bridges and Buildings New York Central & Hudson River Railroad, New York City.

VAUGHN, G. W.,
Engineer in Charge of Joint Track Elevation Atchison, Topeka & Santa Fe Railway and Chicago, Minneapolis & Northern, 405 East Twenty-second Street, Chicago, Ill.

W

WALLACE, J. F., (President),
Assistant Second Vice-President Illinois Central Railroad, Chicago, Ill.

WALLACE, H. U.,
Superintendent Illinois Central Railroad, Freeport, Ill.

WALLACE, J. H.,
Assistant Engineer Maintenance-of-Way Southern Pacific Company, San Francisco, Cal.

WALKER, I. O.,
Division Engineer Nashville, Chattanooga & St. Louis Railway, Paducah, Ky.

WASHINGTON, L. A.,
Assistant Engineer Illinois Central Railroad, Paducah, Ky.

WEBSTER, G. H.,
Engineer Maintenance-of-Way Manitoba & Northwestern Railway, Winnipeg, Man.

WENDT, E. F.,
Assistant Engineer Pittsburg & Lake Erie Railroad, Pittsburg, Pa.

WHEATON, L. H.,
General Superintendent and Chief Engineer Central Railway of Nova Scotia, Yarmouth, N. S.

WHITE, H. F.,
Chief Engineer Burlington, Cedar Rapids & Northern Railway, Cedar Rapids, Iowa.

WHITE, I. F.,
Superintendent Track and Structures Cincinnati, Hamilton & Dayton Railway, Hamilton, Ohio.

WHITTELSEY, T. F.,
General Superintendent Toledo & Ohio Central Railway,
Toledo, Ohio.

WHITTEMORE, D. J., (Director),
Chief Engineer Chicago, Milwaukee & St. Paul Railway,
Chicago, Ill.

WICKHAM, C. E.,
Division Engineer Chicago, Rock Island & Pacific Railway,
Chicago, Ill.

WILGUS, W. J.,
Chief Engineer New York Central & Hudson River Railroad,
New York City.

WILLARD, DANIEL,
Assistant General Manager Baltimore & Ohio Railroad,
Baltimore, Md.

WILLIAMS, H. R.,
General Superintendent Chicago, Milwaukee & St. Paul Railway,
Chicago, Ill.

WILLIAMS, W. D.,
Chief Engineer, Cincinnati Northern Railroad,
Van Wert, Ohio.

WILSON, C. A.,
Chief Engineer Cincinnati, Hamilton & Dayton Railway,
Cincinnati, Ohio.

WILSON, J. T.,
Chief Engineer Pittsburg, Connellsville & Wheeling Railroad,
Moundsville, W. Va.

WOODS, H. A.,
Assistant Engineer Chicago & Grand Trunk Railway,
Detroit, Mich.

WOODWARD, E. K.,
Engineer Maintenance-of-Way Wabash Railroad,
Detroit, Mich.

WOODWORTH, G. B.,
Rail Inspector Chicago, Milwaukee & St. Paul Railway,
Old Colony Building, Chicago, Ill.

Z

ZIESING, A.,
Consulting Engineer,
1324 Monadnock Block, Chicago, Ill.

In Memoriam

◆◆

CLARENCE ALLEN CARPENTER,

Division Engineer Lake Shore & Michigan Southern.

Died November 11, 1899, aged 53 years.

Mr. Carpenter entered the railway service in 1863, taking service with the Adirondack road as rodman. In 1869 he became Assistant Engineer of the Missouri, Kansas & Texas Railway; from 1870 to 1871 he was with the Little Rock & Fort Smith Railway as Assistant Engineer, and from 1871 to 1876 Resident Engineer of the New York & Canada road. During the years 1877-78 he was engaged as Resident Engineer in New York State work; from 1878 to 1880 he was employed on the Central branch of the Union Pacific as Assistant Engineer, and occupied the same position with the Chicago, Milwaukee & St. Paul road for six years, and one year as Division Engineer same road; from the year 1887 he was with the Kansas City line as Division Engineer of Construction and also as Principal Assistant Engineer of the Bridge Department; for a portion of the year 1891 he was with the Northern Pacific in the capacity of Engineer, when he was appointed Division Engineer of the Lake Shore & Michigan Southern, continuing in this position up to the time of his demise.

FERDINAND HALL,

Chief Engineer Chicago, Indianapolis & Louisville.

Died November 22, 1899, aged 44 years.

Mr. Hall's first railway service was with the Burlington & Ohio River Railroad in 1882, and in the same year was appointed Assistant Engineer of the Chicago & Alton Railroad, with which road he remained until 1887, when he received the appointment of Chief Engineer of the Louisville, New Albany & Chicago Railroad, now known as the Chicago, Indianapolis & Louisville Railroad, which place he held until his death.

In Memoriam

RICHARD CAFFREY,

General Inspector of Track Lehigh Valley Railroad.

Died September 26, 1899, aged 62 years.

Mr. Richard Caffrey was born in Ireland, in 1837, and came to this country in 1846, locating in Easton, Pa. He entered the service of the Lehigh Valley Railroad when it was being constructed, and served as foreman from the time it was completed until 1864, when he was made Roadmaster of the Penn Haven and White Haven divisions. When a change was made in the designation of the divisions, in 1874, he was made Roadmaster of the newly-made Lehigh & Wyoming divisions, with supervision over 284 miles of track, and served in this capacity until 1885, when the New Jersey division was added to his territory, increasing the length of lines under his care to 392 miles. In 1890 he was promoted to the office of General Roadmaster of all the Lehigh Valley lines, and in 1896 was made Engineer Maintenance-of-Way, which position he held until the retirement of the Chief Engineer in 1898, when the latter office was abolished, and the duties devolving on the Engineer Maintenance-of-Way, Mr. Caffrey was made General Inspector of Track, with practically the same duties as heretofore. This position he held until his death, which occurred September 26, 1899. He was not a civil engineer, but a thoroughly practical Maintenance-of-Way officer, and enjoyed to the utmost the confidence of his superior officers. He was at one time President of the Roadmasters' Association of America, and at all times one of its most active members.

JOHN CHARLES O'MELVENY,

Chief Engineer Oregon Short Line Railroad.

Died October 3, 1899, aged 39 years.

Mr. O'Melveny entered the railroad service with the Ohio & Mississippi Railway in 1880, and in 1882 was made Assistant Engineer of the same road. During the year 1883 he was engaged in location and railway surveys in Kentucky and Illinois, and from 1883 to 1885 was employed on the preliminary Chicago line of the Santa Fe road. From 1886 to 1897 he was with the Union Pacific as Assistant Engineer in charge of various railroad and bridge work, and from 1897 to the time of his death was Chief Engineer of the Oregon Short Line.

Summary of Circulars Issued.

CIRCULAR NO. 1.

To Railway Engineers and Maintenance-of-Way Officials:

A preliminary meeting for the purpose of organizing a Railway Engineering and Maintenance-of-Way Association was held in Chicago, October 21, 1898, pursuant to call issued by the "Railway Age."

About twenty officials of various railways responded in person, and upwards of one hundred sent communications, approving the movement, and expressing desire to be identified with the organization.

Mr. H. P. Robinson, President of "The Railway Age," Chicago, called the meeting to order, explained its purpose, rendered valuable aid in the initiatory proceedings, and submitted important data as a basis of organization.

Mr. Augustus Torrey, Chief Engineer of the Michigan Central Railroad, Detroit, Mich., was chosen Chairman.

Mr. L. C. Fritch, Superintendent of the Baltimore & Ohio Southwestern Railroad, Washington, Ind., was selected as Secretary.

A committee, appointed by the Chairman, recommended that the Association be entitled "THE AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION." A resolution was passed, adopting this name for the Association.

The Chairman was directed to appoint a committee, consisting of five representative Railway Engineers or Maintenance-of-Way Officials of America, to draft a Constitution and By-Laws, reporting at the next meeting.

The Secretary was directed to communicate with the Railway Engineers and Maintenance-of-Way Officials of America on questions of organization of the Association.

The Chairman was directed to call the next meeting of the Association, to be held at Buffalo, N. Y., early in March, 1899.

CIRCULAR NO. 2.

March 20, 1899.

To American Railway Engineering and Maintenance-of-Way Officials:

A meeting of this Association, for the purpose of adopting a Constitution and perfecting a permanent organization, will be held at the Iroquois Hotel, in Buffalo, N. Y., on Thursday, March 30, 1899, at 10 o'clock a. m.

All officials of American railways interested in the operation, construction or maintenance of railroads are requested to be present at this meeting.

The report of the Committee on Constitution and By-Laws will be submitted at this meeting.

All persons contemplating attendance will please notify the Secretary as early as possible, in order that provision may be made for accommodations.

CIRCULAR NO. 3.

March 31, 1899.

The American Railway Engineering and Maintenance-of-Way Association perfected its permanent organization at a meeting held at Buffalo, N. Y., March 30, 1899.

The Constitution prepared by the Committee was adopted, the charter membership applications passed upon by the Organization Committee, and the following officers were elected:

President—J. F. Wallace, Illinois Central Railroad, Chicago, Ill.

First Vice-President—P. A. Peterson, Canadian Pacific Railway, Montreal, Can.

Second Vice-President—W. G. Curtis, Southern Pacific Railway, San Francisco, Cal.

Secretary—L. C. Fritch, Baltimore & Ohio Southwestern Railroad, Washington, Ind.

Treasurer—W. S. Dawley, Chicago & Eastern Illinois, Chicago, Ill.

DIRECTORS.

For three years:

A. Torrey, Michigan Central Railroad, Detroit, Mich.

Thos. Rodd, Pennsylvania Lines West of Pittsburg, Pittsburg, Pa.

For two years:

D. J. Whittemore, Chicago, Milwaukee & St. Paul, Chicago, Ill.

F. H. McGuigan, Grand Trunk Railway, Montreal, Can.

For one year:

W. K. McFarlin, Delaware, Lackawanna & Western, Hoboken, N. J.

Hunter McDonald, Nashville, Chattanooga & St. Louis Railway, Nashville, Tenn.

CIRCULAR NO. 4.

May 15, 1899.

To Charter Members:

At a meeting of the Board of Direction, held in Chicago, May 12, 1899, an outline of committee-work was submitted, embracing fourteen general subjects, it being proposed to form a standing committee for each general subject.

This outline is herewith submitted for the careful consideration of the members of the Association and others interested. Any suggestions as to additions or modifications are especially invited, to be transmitted to the Secretary before July 1, 1899.

It is also requested that members suggest or designate the names of persons, either members or persons who may become members, that would make suitable or appropriate chairmen or committeemen of the various committees, it being the earnest desire of the Board of Direction that the personnel of the various committees may be based upon the adaptability and fitness of the members composing each particular committee, in order that the best results may be obtained in the work of these committees.

CIRCULAR NO. 5.

Chicago, Ill., November 30, 1899.

To Officers and Managers of American Railways:

The American Railway Engineering and Maintenance-of-Way Association was formally organized March 30, 1899.

The object of the Association is "the advancement of knowlege pertaining to the scientific and economical location, construction, operation and maintenance of railroads."

The membership of the Association may include "any railroad official who is responsible for or has supervision of maintenance-of-way matters, embracing all grades of officials from general managers to engineers of maintenance-of-way in charge of divisions, inclusive, or officials of other titles with similar duties."

The organization is only eight months old and has already attained a membership representing over 140,000 miles of railways and 104 distinct railway companies, embracing lines in United States, Canada and Mexico, some of the individual companies having a membership of twenty-five members.

The work outlined by the Association is on broad and comprehensive lines, and already fourteen standing committees have been chosen to investigate and report upon eighty distinct subjects applicable to the purpose of the Association.

It will be the duty of these committees to make thorough investigation and research into the present practices on the different railways of the country, after which the information will be classified and arranged. From these data certain conclusions and results will be obtained and the recommendations of the committees on the various subjects embodied in the form of reports, which, after discussion by the Association, will be published.

It will be seen, therefore, that the results to be obtained from this method cannot fail to be of vast benefit in attaining a degree of perfection in the economical operation of the Maintenance-of-Way Department that will be invaluable to American railway operation.

The work of the Association is receiving the hearty approval and encouragement of the managements of some of the largest railway systems.

The "Maintenance-of-Way Association" hopes to accomplish for the Maintenance-of-Way Department what the Master Car Builders' and the American Railway Associations are accomplishing for the Maintenance of Equipment and Transportation Departments, and its success will be largely increased by a membership which will include every important railway line in America.

CIRCULAR NO. 6.

Chicago, February 21, 1900.

To Members of the Association:

The annual election of officers of the American Railway Engineering and Maintenance-of-Way Association will be held at the first annual meeting, in Chicago, March 14, 1900.

On account of the Association being practically in process of formation, the Nominating Committee has considered it to be for the best interests of the Association to renominate the officers whose terms will expire, and request them to serve another year.

For the same reason it was deemed expedient to continue those members of the Board of Direction, whose terms expire at this time, for another year—thus, one Vice-President and two Directors, to serve one year; one Vice-President and two Directors, whose terms would expire a year hence, to serve for two years; two Directors, whose terms expire in two years, to serve three years.

Members desiring to cast their votes for others than those submitted by the Nominating Committee will please do so on the blank space under each name on the ballot.

[Circular No. 7—Establishing Headquarters in Chicago.]

CIRCULAR NO. 8.

Chicago, March 3, 1900.

To Chairmen of Committees:

At the annual meeting in March it is the intention to handle the reports of the general standing committees in the following manner:

Each chairman is expected to present a brief, concise paper, outlining the subject-matter to be considered by his committee, and the manner in which the committee-work shall be carried on. It is desired that each chairman shall organize his committee prior to the opening of the convention, and that during the reading and discussion of his paper he shall have his committee seated in the front body of the room, seated at the right of the Chairman; each chairman should read his own report, or, in his absence, the vice-chairman, and if both should be absent, some other member of the committee; it is then expected that this report shall be thrown open for general discussion by the members of the Association at large, and the chairman or members of the committee are expected to answer any questions that may be asked in relation to the report or the work of the committee.

It is desired that these reports serve as a preface or introduction to the consideration which in years to come may be given to the subject-matter, and that the substance of the various reports and the method

of handling the work of each committee shall be fully and freely discussed by the general membership of the Association, in order that the various chairmen, their committees and the general members may be fully advised of how each committee's work is to be carried on.

You will, of course, note from the printed outline of committee-work that the scheme is a comprehensive one, and that it will provide plenty of work for the various committees and the Association at large during the lifetime of the present members at least. It is not intended to exhaust the subject-matter of any committee in one year, or even within the lifetime of the members. The idea is to provide a basis for a thorough, scientific and systematic investigation of all matters connected with the objects of the Association, a field of research and consideration which is practically inexhaustible.

If the chairmen of the various committees have not already done so, they will please at once advise the Secretary of their purpose to be present at the annual meeting, and at the same time (or as soon as they can get their reports ready) send a copy of same to the Secretary, so he can have it printed and ready for use at the meeting. If, for any reason, the chairman of any committee cannot be present, he will please call on his vice-chairman to attend and read the report of his committee; and if the vice-chairman should also be unable to attend, arrange with some other member of the committee to be present and read the report.

Chairmen of committees are requested to call meetings and organize their committees prior to the opening of the convention, and arrange for frequent meetings of their committees between the sessions of the main body of the Association, or at such other times as may be convenient, so as to maintain their organization throughout the period of the convention.

STATEMENT SHOWING THE MILEAGE OF THE ROADS REPRESENTED BY MEMBERS OF THE AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION.

Name of Road.	Mileage.	No. of Members.
Algoma Central Railway	60	1
Ann Arbor Railroad	292	1
Arkansas Northern Railway	125	1
Atchison, Topeka & Santa Fe Railway	6,094	2
Baltimore & Ohio Railroad	2,048	5
Baltimore & Ohio Southwestern Railroad	933	5
Boston & Albany Railroad	394	1
Buffalo & Susquehanna Railroad	162	1
Buffalo, Rochester & Pittsburg Railway	338	1
Burlington, Cedar Rapids & Northern Railway	1,136	2
Canada Atlantic Railway	448	1
Canadian Pacific Railway	7,684	5
Centralia & Chester Railroad	100	1
Central New England Railway	181	1
Central Railway of Nova Scotia	74	1
Central Vermont Railway	511	2
Chesapeake & Ohio Railway	1,465	2
Chicago & Alton Railway	902	6
Chicago & Eastern Illinois Railroad	710	3
Chicago & North-Western Railway	6,676	3
Chicago & Western Indiana Railroad	55	1
Chicago, Burlington & Quincy Railroad	6,231	3
Chicago Great Western Railway	932	1
Chicago Junction Railway	297	1
Chicago, Milwaukee & St. Paul Railway	6,382	5
Chicago, Peoria & St. Louis Railroad	282	1
Chicago, Rock Island & Pacific Railway	3,619	2
Chicago Terminal Transfer Railroad	214	4
Chicago Transfer & Clearing Company	100	1
Choctaw, Oklahoma & Gulf Railroad	563	1
Cincinnati, Hamilton & Dayton Railway	653	2
Cincinnati Northern Railroad	415	1
Cleveland, Akron & Columbus Railway	219	1
Cleveland, Cincinnati, Chicago & St. Louis Railway	2,345	6
Cleveland, Lorain & Wheeling Railway	196	1
Copper Range Railroad	40	1
Delaware, Lackawanna & Western Railroad	920	1

Name of Road.	Mileage.	No. of Members.
Denver & Rio Grande Railroad	1,673	2
Detroit & Mackinac Railway	314	1
Duluth & Iron Range Railroad	185	1
Erie Railroad	2,271	2
Esquimalt & Nanaimo Railway	80	1
Evansville & Terre Haute Railroad	317	1
Federal District Railway of Mexico	220	1
Fitchburg Railroad	458	2
Florence & Cripple Creek Railroad	43	1
Florida Central & Peninsular Railroad	942	1
Fremont, Elkhorn & Missouri Valley Railroad	1,363	1
Grand Trunk Railway	4,186	4
Great Northern Railway	4,094	1
Gulf, Colorado & Santa Fe Railway	1,128	3
Hocking Valley Railway	346	1
Houston & Texas Central Railroad	565	2
Houston East & West Texas Railway	232	1
Illinois Central Railroad	3,996	30
Iowa Central Railway	533	1
Kansas City, Fort Scott & Memphis Railroad	1,243	2
Lake Shore & Michigan Southern Railway	1,413	3
Lehigh Valley Railroad	1,393	1
Long Island Railroad	409	2
Louisville & Nashville Railroad	3,158	2
Manitoba & Northwestern Railway	250	1
Mexican Central Railway	2,012	1
Mexican International Railway	731	1
Mexican National Construction Company	89	1
Mexican National Railroad	1,266	1
Michigan Central Railroad	1,679	5
Minneapolis & St. Louis Railroad	602	1
Missouri, Kansas & Texas Railway	2,208	1
Missouri-Pacific Railway	5,394	1
Mobile & Ohio Railroad	687	1
Montana Railroad	100	1
Nashville, Chattanooga & St. Louis Railway	1,189	4
National Docks Railway	23	1
Nevada County Narrow-Gauge Railroad	23	1
New York Central & Hudson River Railroad	6,295	5
New York, Chicago & St. Louis Railroad	533	2
New York, New Haven & Hartford Railroad	2,047	1
New York, Philadelphia & Norfolk Railroad	112	1
Norfolk & Southern Railroad	104	1
Norfolk & Western Railway	1,551	1
Northern Pacific Railway	4,887	1
Ocos Railway	30	1

Name of Road.	Mileage.	No. of Members.
Ohio River Railroad	269	2
Pennsylvania Lines West of Pittsburg	4,657	9
Pennsylvania Railroad	3,726	4
Peoria & Eastern Railway	350	1
Pere Marquette Railroad	1,884	2
Philadelphia & Reading Railway	1,114	3
Pittsburg & Lake Erie Railroad	180	4
Pittsburg & Western Railway	343	1
Pittsburg, Connellsville & Western Railway	100	1
St. Louis & San Francisco Railroad	1,642	1
San Francisco & San Joaquin Valley Railway	304	2
Santa Fe, Prescott & Phoenix Railway	224	1
Seaboard Air Line	961	1
South Haven & Eastern Railroad	100	1
Southern Pacific Company	7,411	19
Southern Railway	6,064	8
Terminal Railroad Association of St. Louis	18	1
Terre Haute & Indianapolis Railroad	430	1
Terre Haute & Logansport Railway	182	1
Toledo & Ohio Central Railway	543	1
Union Elevated Railroad of Chicago	10	1
Union Pacific Railroad	2,848	2
Vera Cruz & Pacific Railroad	85	2
Wabash Railroad	2,321	3
Waycross Air Line	70	1
Western New York & Pennsylvania Railway	633	2
Wheeling & Lake Erie Railroad	415	1
Wisconsin & Michigan Railway	72	1
Wisconsin Central Lines	1,004	2
Yazoo & Mississippi Valley Railroad	1,006	3
Miscellaneous		18
Total	155,236	279

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